Engineering News

Vol. 68, No. 24 505 Pearl Street, New York December 12, 1912

The Trafford Park Industrial District at Manchester, England

The construction of the great Manchester Ship Canal, converting the inland city of Manchester, England, into a seaport, had naturally a great effect in increasing the trade and commerce of the city and of the entire district tributary to it. The growth of manufacturing industry, however, has not been left to a slow and unassisted development, but has been fostered and encountered in an active and and enterprising manner. By far the greatest development has been that of the Trafford Park Estates, which represents quite a new feature in industrial enterprise. The ship canal, with its docks and auxiliary works, is described elsewhere in this issue, and we give herewith some account of this other enterprise, which is related intimately with the prosperity of the canal and the city.

Just beyond Manchester, the property of the ship canal skirts Trafford Park (1200 acres), which was for many years the property of the Trafford family. The location of the estate is indicated on Figs. 1 and 2 on p. 1080 of this issue, and it will be seen that it is a quadrilateral tract extending from Manchester to Barton, bounded on two sides by the Manchester Ship Canal and on the other two sides by the Bridgewater Canal, which is one of the large inland navigation systems. The property thus has 6½ miles of water front.

Under the conditions following the construction of the Manchester Ship Canal and its docks, with the park practically surrounded by manufacturing and commercial industries, the estate became undesirable for residence purposes. At the same time, the commercial interests saw that to develop the commerce of the city and the canal it would be necessary to provide ample room for expansion and for the establishment of manufacturing sites. The park offered an excellent opportunity for the development of an industrial district, adjacent to the city, but not hampered by existing conditions of roads, buildings, or private interests. A company was organized, therefore, under the name of the Trafford Park Estates, which acquired the entire property, and has already secured the establishment of nearly a hundred industrial plants, of varied character.

Among the advantages of the site are: 1, the practicability of manufacture and storage adjacent to deep-water terminals used by coastwise and ocean steamers; 2, plentiful supply of labor (skilled and unskilled); 3, electric current at low rates for light and power; 4, proximity to a large coal district; 5, deep-water and inland navigation connections, and 6, direct railway connections to all parts of the country. Every site purchased or leased is entitled to have its own railway siding and there are already some 10 miles of railway track laid. By special agreement with the ship-canal company, freight is handled between the docks and any part of the estate by the company's cars at a uniform rate of 12c. per ton, including the use of the car. In many cases the factories receive raw material and ship finished products by the ship canal. For cartage, the district is included within the Manchester delivery area.

In addition to the industrial plants there are on the property 700 residences (mainly for workmen), two banks, a large hotel, post office, electric generating station, three churches, schools, a residential club, and a police station. The old residence of the estate, Trafford Hall, is maintained as a club for the use of the company's directors and officers, and their visitors. This is surrounded by a small area of the original park. Water is obtained from the city's water-supply system, whose mains have been extended across this tract of land. Additional supplies, however, can be obtained from the Bridgewater Canal or by sinking wells into the red sandstone which underlies

FIG. 1. INTERIOR OF FIREPROOF SECTIONAL STORAGE WAREHOUSE FOR FREIGHT OR COTTON

the property. A main sewer traverses the property, and gas is obtained from the Manchester gas company's mains. The city electric street-railway system has been extended into Trafford Park and will be extended further as the property is built up, so that there are ample rapid-transit facilities.

This industrial district has been laid out to provide sites for both large and small plants, and as the freight-handling charge is uniform (as noted above) all the sites are practically of equal advantage. The traffic on these transfer lines (between the canal docks and the factories) is about 700,000 tons per year. At present about 400 acres have been sold or leased. The most extensive plant by far is that of the British Westinghouse Electric & Mfg. Co. The American Car & Foundry Co. has a plant here, which was established originally for the erection of cars built in the United States for one of the London underground rapid-transit railways, but which now carries on a general car-manufacturing industry for European and foreign business. Other industries included are machinery and machine tools, oil refineries, saw mills, flour mills and food stores, railway axles and wheels, glass bottles, chemical works, cars for electric railways, electric cables and supplies, lead pipe, wood-paving blocks, etc. Besides these there are yards for the storage of timber, brick, iron and structural steel, etc.; also railway yards and warehouses for railways, the canal company and private firms. One of the largest flour mills is across the road from the ship-canal company's elevator and obtains its grain direct through a subway.

It is pointed out that raw material and manufactures may be received and shipped either in full cargoes or as parts of general cargo (the latter being more generally the case), and as ships carrying general cargo are available to and from many parts of the world, the small manufacturer has as good facilities as the larger one. Further, there are few other ports in Great Britain having so many lines of freight steamers, while Manchester is the only one having land for manufacturing facilities adjacent to the port.

Sectional Warehouses

A special feature of the warehousing accommodation is the provision of cellular fireproof storage houses (or "storage safes," as they are called) for the use of firms requiring small or moderate space, and for the sectional storage of such material as cotton in small lots. One firm may rent one or more cells or compartments as required. The new fireproof safes for cotton storage, completed in September, 1912, form a one-story reinforced-concrete building about 320x165 ft., divided by hollow or double partition walls into nine compartments 165x35 ft., and 44½ ft. high. A cross-section of this is shown in Fig. 2.

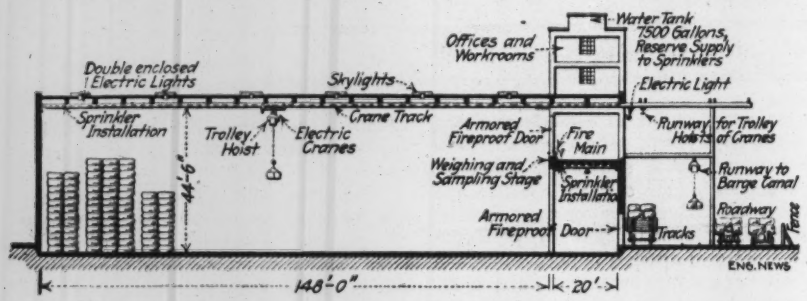


FIG. 2. CROSS-SECTION OF FIREPROOF SECTIONAL STORAGE WAREHOUSE FOR COTTON AT TRAFFORD PARK, MANCHESTER, (ENGLAND)
(Nine sections, 165x35x44½ ft., each holding 5000 bales of cotton.)

The building lies between railway tracks and the Bridgewater barge canal, and along its front extend a double-track railway and a roadway. A gallery or open upper floor 20x35 ft., and 25 ft. above the main floor, serves as a weighing and sampling stage. Each compartment has three electric overhead traveling cranes and along the front of the building is a frame carrying extensions of the runways, so that the cranes can be run out over the cars and wagons. The crane bridges can be lined up here so as to form a continuous longitudinal single-beam runway, and in this way trolleys can be transferred from one compartment to another. The hoisting speed is 80 ft. per min. and the speed of the crane bridge is 500 ft. per min. The same frame carries a single-beam runway for trolleys serving the canal barges; the speed of these trolleys is 800 ft. per min.

The roof is flat, of reinforced-concrete construction, with wire-glass skylights and electric lights (in the ceiling) inclosed in double globes. All electric wiring is on the outside. Each compartment has a complete sprinkler system supplied from the mains and from a 7500-gal. tank on the roof. It has also a standpipe or riser on the weighing stage which is connected to a special fire-supply main served by an electric pump. In case of fire in any compartment a monitor or revolving nozzle can be fitted to the head of the standpipe and a stream of water thrown to any part of the compartment. There are no windows and only two doorways; one opening onto the weighing stage and the other at the ground level. These have armored fireproof doors.

The first of these storage safes was a six-compartment building 180x111 ft., and 30 ft. high, divided into chambers 111x30 ft. The construction is similar to the large structure described above, but the two doors of each compartment are at opposite ends and both at the floor level. The elevated tank for auxiliary fire supply is placed on the roof of a masonry tower adjacent to the building. Ventilating ducts are provided near the top of the wall, but each is fitted with a flue turned up vertically on the inside so that no sparks can enter. Fig. 1 is an interior view of one of the compartments.

Along each side of the building is a platform level with the concrete floor. The platform on one side is adjacent to a paved driveway, and this side of the building has a revolving jib crane mounted over the doorway. The horizontal jib carries a hoisting trolley, so that packages can be transferred between the storehouse and wagons. On the opposite side of the building is a double-track railway line, spanned by an electric traveling crane which has one runway along the wall and the other carried by built-up steel columns outside of the tracks. Upon the traveling bridge runs a hoisting trolley. In each compartment is a light electric traveling crane whose movements are controlled by hanging chains. By this means the bales or other packages can be stacked nearly to the roof. The bridge is of I-beams, with the hoisting trolley carried beneath it.

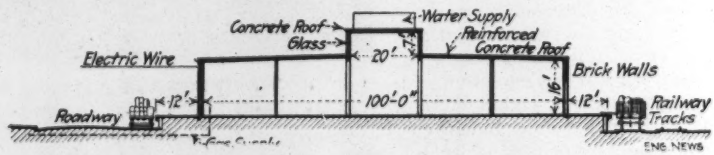


FIG. 3. CROSS-SECTION OF FIREPROOF SECTIONAL BUILDING FOR LIGHT MANUFACTURING WORK AT TRAFFORD PARK, MANCHESTER (ENGLAND)

Each section or cell can hold 5000 bales of cotton. One important result of establishing this sectionalized system of storage for cotton has been a great

reduction in insurance, the rates for cotton stored in this way being only 20 to 30% of the rates demanded where it is stored in quantities in the ordinary large fireproof cotton warehouses.

Sectional Factory Buildings

To provide for accommodations for small manufacturers, a special factory building has been erected, and this is divided into separate sections, in the same way as the storehouses mentioned above. The building is 100x360 ft., 16 ft. high, its length being divided by partition walls to form sections 24x100 ft. Any number of sections may be leased by one firm. The length of the building will be increased as required, and space is provided for a second building parallel with the first. The walls are of brick, with large doors and windows, and the floor is of concrete. The flat roof is of reinforced concrete, supported by the walls and four lines of columns, forming five spans of 20 ft. Over the central span is a 20-ft. monitor 7 ft. high, with glazed sides and flat roof. Upon this upper roof is a water tank. Fig. 3 is a section of this building.

Each compartment has connections for gas and electricity. Along each side of the building is a platform 12 ft. wide and level with the floor; one of these is alongside a paved driveway and the other is alongside of a double-track railway. The platforms are level with the floors of cars and wagons. When the second building is erected there will be a third track, providing two house tracks and a middle running track. This building provides not only for established manufacture, but for experimental work and the development of patented processes or apparatus; this last is important since the English patent law provides for revoking patents after four years of their life if the inventions are manufactured only in other countries.

The company, which bears the name of the Trafford Park Estates (Limited), has a capital of $6,000,000; the Chairman is Col. Paget Mosley and the Managing Director, is Marshall Stevens. The latter was one of the promoters of the Manchester ship-canal project from its early days, and was at one time manager of the canal.

The Inland Port of Manchester

The inland city of Manchester (England) became a port in 1894, when brought into direct communication with the sea by the completion of the Manchester Ship Canal. But the canal was only one of the many works required to constitute a commercial port which could compete with old-established seaports. Docks, warehouses, freight-handling facilities, etc., had to be provided on a large scale and at great expense. The results have been so successful that Manchester now ranks as the fourth port in Great Britain. The engineering works of the ship canal are already on record, and the article given herewith deals with the port as a whole, including its physical features and facilities, and its commercial development.

The city of Manchester is one of the leading commercial and manufacturing cities of England and is the center of a great manufacturing district which includes the cotton and textile mills of Lancashire. The population of the city (including its suburb of Salford) is about 765,000; the total population of the adjacent district is about 3,778,000 within a radius of 25 miles, and 8,726,000 within a radius of 50 miles. Since the construction of the Manchester Ship Canal it has become a leading port, and ranks now as the fourth port in Great Britain, based on the total of imports and exports. The figures for 1909 are given in Table I.

TABLE I. COMMERCE OF LEADING BRITISH PORTS

	Imports	Exports	Total
	(Millions of dollars)		
London	$1028	$685	$1713
Liverpool	743	748	1491
Hull	198	136	334
Manchester	145	73	218

The city is about 50 miles from the open sea and 35 miles from natural deep water available for navigation. It is built on a small stream, the River Irwell, which flows into the River Mersey. The latter also is a small stream, and is unimportant above the tidal influence (which extends to Warrington), but upon its estuary is located the great port of Liverpool. The advantage of the river in relation to the canal project was in providing a valley route to the sea, and in giving a sufficient flow of water to feed a large canal.

Projects for providing water communication between Manchester and Liverpool date back some 200 years, and two of these were carried into effect. The first was the improvement of the rivers Mersey and Irwell to accommodate barges of 50 tons capacity, drawing 5 ft. of water, and this was first projected in 1710. Later, came the Bridgewater canal, which practically superseded the river route. The advent of railways checked the schemes for ship canals which were put forward at intervals in the early part of the last century, but with the growth of the city and the railways there was increasing complaint as to the high cost and inadequate service of the railways, which were accused of discriminating in favor of Liverpool.

The project which resulted eventually in converting the inland city of Manchester into a seaport available for large ocean steamers dates back to 1882. According to Marshall Stevens, who was intimately connected with the project from its beginning, a meeting of business men was held in 1882 to consider a tidal-navigation scheme without locks, which had been proposed by a Mr. Fulton, an engineer. This scheme was rejected for the reason that the docks at Manchester would be some 80 ft. below the level of the ground, but a proposition for a lock canal was considered and adopted. In 1883, application was made to Parliament for authority to carry out the work, and this was opposed vigorously by the railways, the city of Liverpool and other interests that considered themselves to be affected adversely. Under the English system of promoting public works of this kind there was a protracted and costly fight for three years, but the act was passed finally on Aug. 6, 1885. The cost of the canal was originally estimated at £8,262,936 (about 40 million dollars) and the contract was let at this figure, but the actual cost by the time the canal was opened in 1894 was nearly $75,000,000, due largely to increased dimensions, additional auxiliary works, and unforeseen contingencies.

It was attempted at the outset to raise the necessary $40,000,000 by public investment, but the attempt proved a failure, as investors appeared to have no interest or confidence in the project, and the promoters had to turn to the large banking concerns. The requisite 66% of the share capital was not raised until August, 1887, a few days before the company's rights would have expired if this had not been done. The construction was commenced Nov. 11, 1887, but the death of the contractor two years later seriously interfered with the progress of the work. The canal company finally had to take it over from the contractor's executors and complete the work itself.

So far the city of Manchester had had no connection with the canal enterprise. But when it was found that the subscribed capital was not sufficient to complete the work, the Manchester corporation was asked to assist, in view of the expected benefit of the canal to the city. After an investigation by an engineer on behalf of the city, the corporation obtained authority from Parliament to ad-

vance $15,000,000. At the same time it secured from the canal company an agreement that the corporation should have the appointment of a majority of the Board of Directors and the control of all expenditures. Later on it proved necessary for the city to obtain authority to add $10,000,000 to its previous investment.

The canal was opened to traffic on Jan. 1, 1894, its construction having occupied about six years. The capital expenditure to the end of 1911 was $84,041,650.

Time has proved that the caution of the original investors was justified, as the canal has never paid a dividend to the stockholders. In fact its net earnings have only been sufficient to pay the interest on the $25,000,000 loaned by the city of Manchester and, at the close of 1909, there still remained $35,000 interest on the city's loan in arrears. At the present time, however, all of this interest has been paid.

In the early years of its operation the traffic and earnings were far below what its promoters had estimated. For example, while the promoters estimated net revenues of $2,397,150 for the second year of operation of the canal, the gross revenue in that year was little more than one-fourth of this amount. The total traffic in that year was 1,358,875 tons. By 1900 the traffic had increased to 3,060,516 tons, and in 1907 the total traffic was 5,210,759 tons. In the years since that time the traffic showed a decrease (although it continued higher than for any year previous to 1906), until 1911. This slightly exceeded the traffic of 1907, showing gross earnings of $2,904,200 and a tonnage of 5,217,812 tons; and it is to be noted that there were unfavorable conditions in 1911, owing to the prolonged strikes of the dock-men and those of the railway employees on many lines entering Manchester. Of the above total tonnage for 1911 the barge or inland-navigation traffic represented over 300,000 tons.

While the returns of the canal to those who invested in it have been disappointing, it is claimed that its benefit to Manchester trade and commerce has been enormous, in addition to the advantages due to reductions in port charges, shipping rates and railway rates. The total receipts of the ship canal for 1910 were $2,778,675; the expenditures were $1,383,750. It is of interest to note that Manchester, which is less than 20 years old as a port, now ranks as the fourth port of Great Britain in value of imports and exports. It is the second in cotton and oil handled; the third for fruit, the fifth for timber, and the sixth for grain. For the year 1911, the total value of foreign imports at Manchester and at the four landing points along the canal (included in the port) was $162,515,000, and that of the exports was $108,205,000, making a total of $270,720,000, or $33,500,000 more than in 1910.

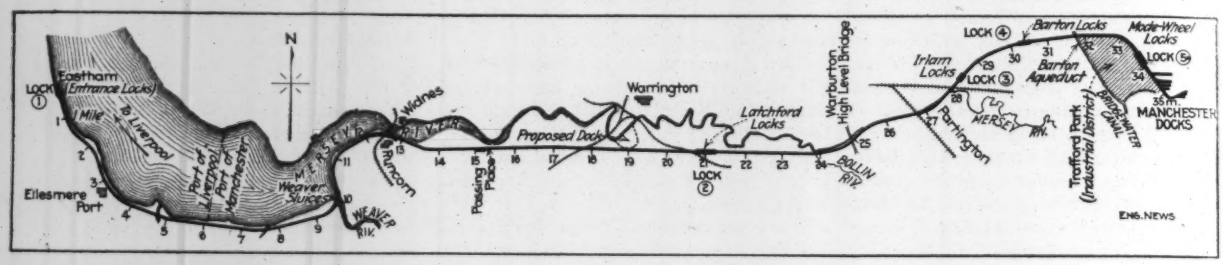


FIG. 1. MAP OF THE MANCHESTER SHIP CANAL

PHYSICAL CHARACTERISTICS OF THE SHIP CANAL

The Manchester Ship Canal, of which a general map is shown in Fig. 1, has a length of 34 miles from the river lock on the Mersey at Eastham (six miles above Liverpool) to the Mode-Wheel lock forming the entrance to the Manchester docks. The total length, including the dock portion, to the actual head of the canal at its connection with the River Irwell is 36 miles. The depth is now 28 ft. throughout. The average bottom width is 120 ft., but at some points it is increased to 150 to 180 ft., while for about a mile above Latchford it is only 90 ft. The ordinary width is increased at the locks, at turning basins, and at points where coaling and other facilities are provided. Below the bridge at Runcorn the canal is being widened to a bottom width of 220 ft. for a distance of 1300 ft., in order to provide increased facilities for shipping as well as to improve the navigation. The river entrance to the Eastham locks is also being widened and deepened.

LOCKS AND BRIDGES—The difference in water level between the Manchester docks and the mean tide level in the River Mersey at Eastham is about 60 ft. This is overcome by five sets of locks, which are located at the River Mersey connection, at the docks, and at three intermediate points. At the river connection there are three parallel locks, and at each of the other points there are two parallel locks. The upper sills of all the large locks are 28 ft. below normal water level. At six points along the canal there are subsidiary locks forming lateral connections with the river, or other inland waterways, and ranging in size from 85x20 ft. to 600x45 ft. The dimensions of the canal locks are given in Table II. A ship can be passed through the largest locks in about eight minutes.

TABLE II. LOCKS OF THE MANCHESTER SHIP CANAL

	Size ft.	Lift Ft.	Width of Canal Ft.
Eastham (River Mersey)	600x80, 350x50 and 150x30	..	315
Latchford	600x65 and 350x45	14½	290
Irlam	600x65 and 350x45	16	370
Barton	600x65 and 350x45	15	330
Mode-Wheel (Manchester docks)	600x65 and 350x45	13	320

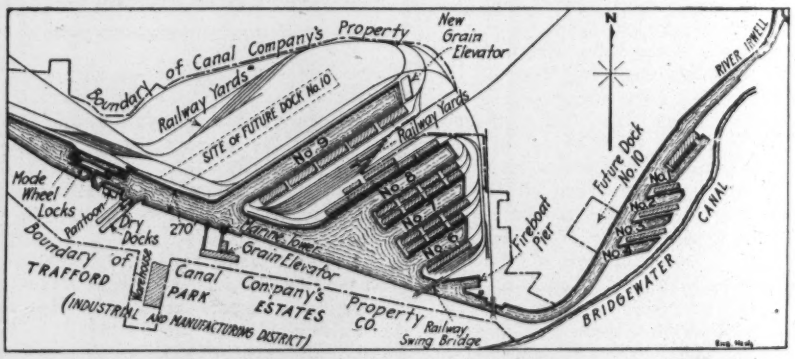


FIG. 2. PLAN OF DOCKS AND PORT FACILITIES AT MANCHESTER, ENGLAND

BRIDGES—The canal route was crossed by four lines of railway, but the first of these (at Runcorn) was already at a height of 78 ft. above the water, the Admiralty having required this height for the bridge over the Mersey with a view

to navigation extending above it. The other lines crossed the route at a low level, but the act authorizing the canal required that the railways should provide swing bridges. The canal company, however, recognized the serious objections to swing bridges on busy main lines, and proposed that the railways should be raised to permit of using fixed spans giving a clear headway of 74½ ft. This plan was adopted in each case, but necessitated extensive diversion and reconstruction work to secure reasonable grades for the approaches. There are now five fixed railway bridges, seven highway swing bridges of 120 ft. span (except one of 90 ft.), and two high-level cantilever fixed highway bridges having center spans of 206 ft. The Bridgewater Canal (for barges) is carried across the ship canal by the Barton Aqueduct, 235 ft. long, 18 ft. wide and 6 ft. deep; this has a bridge covering two 90-ft. spans in which water is retained by end gates when the span is swung, the total swinging weight (including the water) being 1450 tons.

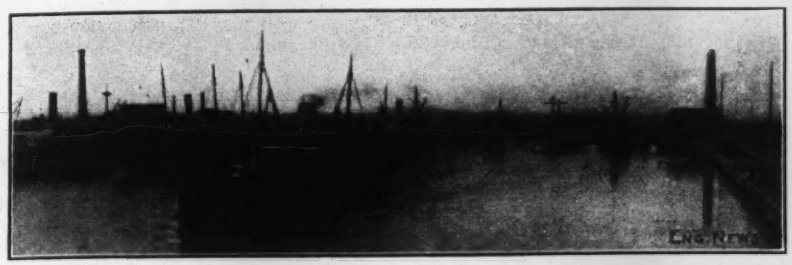


FIG. 3. ENTRANCE TO THE MANCHESTER DOCKS; MANCHESTER SHIP CANAL
(In the background are the two parallel locks; 600x65 ft. and 350x45 ft. The hydraulic power station and tower are at the right, and the dry-docks and ship-repair yards at the left.)

Many of the large ships in the Manchester trade could not pass under the 74½-ft. headway of the fixed bridges, and in fact shipowners are advised to consider 70 ft. as the limit in order to provide against trouble due to a reduction of headway by floods, etc. The large vessels, therefore, must lower their topmasts and sometimes their funnels also. For this work, special equipment is provided a short distance above the entrance locks, while berths along the canal are provided for large sailing ships which cannot lower their masts to the bridge limit. Particulars of these special facilities are noted later. The ship canal is tapped by no less than 14 barge canals, representing an aggregate of about 750 miles of inland waterway.

MANCHESTER DOCKS AND FREIGHT FACILITIES

The Manchester docks at the head of the ship canal are designed on the pier-and-slip system, as will be seen by the plan, Fig. 2. The more general practice at English ports is to provide basins or docks approximately rectangular, the ships being moored at the sides to load or discharge cargo, and sometimes being moored in the middle of the basin when waiting for orders, etc. Where the basins are very large, a wide solid pier may be extended from one side to increase the length of quay or berth space. These rectangular basins are found almost invariably where the closed dock system is used; that is, where the docks are connected with the open water of a river or bay by means of locks in order to maintain a permanent level of water in the docks, irrespective of the tidal variation outside. At Manchester there is no tide, but a lock is provided at the connection with the canal, so that variations in level due to lockages (at points along the canal) or possible accidents will not affect the level of water in the pool or floating harbor.

The general arrangement of the docks (with the piers, sheds, warehouses, etc.), is shown in Fig. 2, and it will be seen that these are in two groups. The smaller group (Nos. 1 to 4) is above the railway drawbridge, and opposite these will be No. 5, which as yet is only partly constructed. The large sea-going vessels are berthed in the docks of the other group, which is immediately above the main entrance locks (the Mode-Wheel locks). Fig. 3 is a view just inside these locks, which are seen in the background. At the right of the locks are the engine house and accumulator tower for the hydraulic machinery of the dock system, and at the extreme right is one of the traveling tower cranes. At the left are the dry docks and ship-repair yard.

Above the locks there is a channel 270 ft. wide, from which opens the largest slip or dock (No. 9), which is 250 ft. wide and 2700 ft. long. This dock has a water area of 15.6 acres, and is at such an angle with the channel as to facilitate the handling of ships in entering and leaving. It was opened in 1905, and provision has been made for another large dock adjacent to it (Dock No. 10), as shown. The large dock (No. 9) is shown in Fig. 4; on the right are the four-story freight sheds, with cranes on the roofs and on the dock space between the sheds and the shipping. In the center of the view is a canal tow-boat with a tow of barges. The channel above Dock No. 9 is widened to form a basin from which extend three smaller docks. The total area of the dock space is 407 acres, of which 120 acres are water and 287 acres are land. The present eight docks provide a total water front or berthing space of 6½ miles. The depth of water is 28 ft. Dredging is required both in the docks and in the canal, as the river brings down large amounts of sediment after heavy rains. The dimensions of the docks are given in Table III.

TABLE III.—DIMENSIONS OF THE DOCKS AT MANCHESTER, ENGLAND

Dock No.	Size ft.	Dock No.	Size ft.
1	700x120	6	850x225
2	600x150	7	1160x225
3	600x150	8	1340x250
4	560x150	9	2700x250
5	980x750		

PIERS AND SHEDS—The piers are much wider than is usual in American practice, ranging from 250 to 750 ft. As is usual in foreign harbor works, they are solid piers of very substantial construction, with dock walls or quay walls of concrete faced with granite. The top of the wall is 8 ft. above the normal water level. In most cases each pier has a double line of freight sheds or warehouses, with railway tracks between them and along the quay walls. The buildings are from one to seven stories in height, some being of reinforced concrete and others of brick with steel roof trusses.

In the freight sheds or transit sheds the freight or cargo is handled directly between ships and cars, with only temporary storage. These include 13 one-

FIG. 4. DOCK NO. 9 (2700x250 FT.); MANCHESTER SHIP CANAL
(Copyright, R. Banks, Manchester, England.)

story, 1 two-story, 6 three-story, 5 four-story and 12 five-story sheds. They are fitted with modern appliances, and include a cold-storage shed for the sorting of frozen meat and other produce. The more recent sheds have flat roofs, which serve for the storage of goods which need not be under cover, and which ordinarily are stored on the open quay. In this way the ground space is left unobstructed.

These transit sheds are used for handling the large proportion of inbound cargo which has to be sorted, weighed, etc., before being forwarded. No freight is allowed to remain in these sheds (or upon their roofs) for more than 48 hr., so that the handling of freight is quite distinct from the storage of freight. On the south side of the largest dock there are five reinforced-concrete transit sheds having three floors and a flat roof; they are 110 ft. wide, have a total length of 2150 ft., and give a total floor area of 110,000 sq.yd. For storage purposes there are 13 seven-story warehouses, each having 27 friction hoists operated by gas engines. The canal company has also in the Trafford Park district (noted elsewhere in this issue) four lofty one-story warehouses, each 300x100 ft. An excellent idea of the general design and arrangement of the buildings is given by the plan Fig. 2, and the cross-sections in Fig. 5.

CRANES—Extensive crane equipment for the mechanical handling of freight and cargo is a feature of English ports (as noted in our issue of Sept. 12, 1912), and special care has been taken to give Manchester a very complete equipment of this sort. Most of the quays or piers have hydraulic cranes traveling on tracks laid at the ground level, but the new flat-roof sheds have traveling cranes along each side of the roof. This gives valuable space, by enabling the building to be set closer to the edge of the quay, and it avoids all interference with traffic on the quays. The flat roof provides storage for articles ordinarily stored on the open quay, as noted above. There are electric cranes also in the buildings. The general arrangement of the dock and roof cranes is shown in Fig. 5. Of the cranes, 53 are hydraulic and 91 electric; they have a working reach or radius of 16 to 40 ft., and a hoisting capacity of 1 to 10 tons, with a lift of 13 to 60 ft. above rail level. There are also 30 hydraulic and 16 electric capstans on the quays, which are used largely for handling railway cars by means of ropes. In addition there is a 30-ton steam crane for very heavy work, and also a floating crane or shear-legs having a hoisting capacity of 250 tons and a clear lift of 21 ft.

GRAIN ELEVATOR—The grain elevator has 268 bins, with a total storage capacity of 40,000 tons or 1,500,000 bu. It covers a larger area and is of less height than similar elevators in American practice, as will be seen from Fig. 6. It stands back from the quay and is served by two sets of conveyors extending from the marine tower on the dock wall. It can unload vessels at the rate of 350 tons per hour, and handle and weigh the grain (in bulk) in the house at a rate of 500 tons per hour. It can sack the grain, weighing the sacks and loading them into 40 railway cars or 10 wagons simultaneously. Further, it can deliver grain from the bins into barges or coasting steamers at the rate of 450 tons per hour in bulk, or 120 tons (1075 sacks) if sacked. An auxiliary to the elevator is a Metcalf dryer, having a capacity of 50 tons; the grain can be handled between the dryer and any one of the bins.

In view of the enormous increase in the grain imports (from 35,688 tons in 1895 to 502,000 tons in 1911), a second elevator is to be built, having a capacity of 50,000 tons. This will be at the head of Dock No. 9. Its necessity was foreseen when this dock was built, and the foundations were built at that time, while subways for grain conveyors were formed in the dock walls, as shown in Fig. 5. This foresight will enable the elevator and its conveyors, etc., to be built without interference with shipping or traffic.

Some of the grain steamers have a depth of hold of nearly 40 ft., which needs a very long elevator leg for unloading. It was found that the maximum unloading capacity could not be obtained with such long legs of the usual type, and the elevator has been equipped, therefore, with eight suction pipes for unloading grain from different parts of the hold by the vacuum process. These

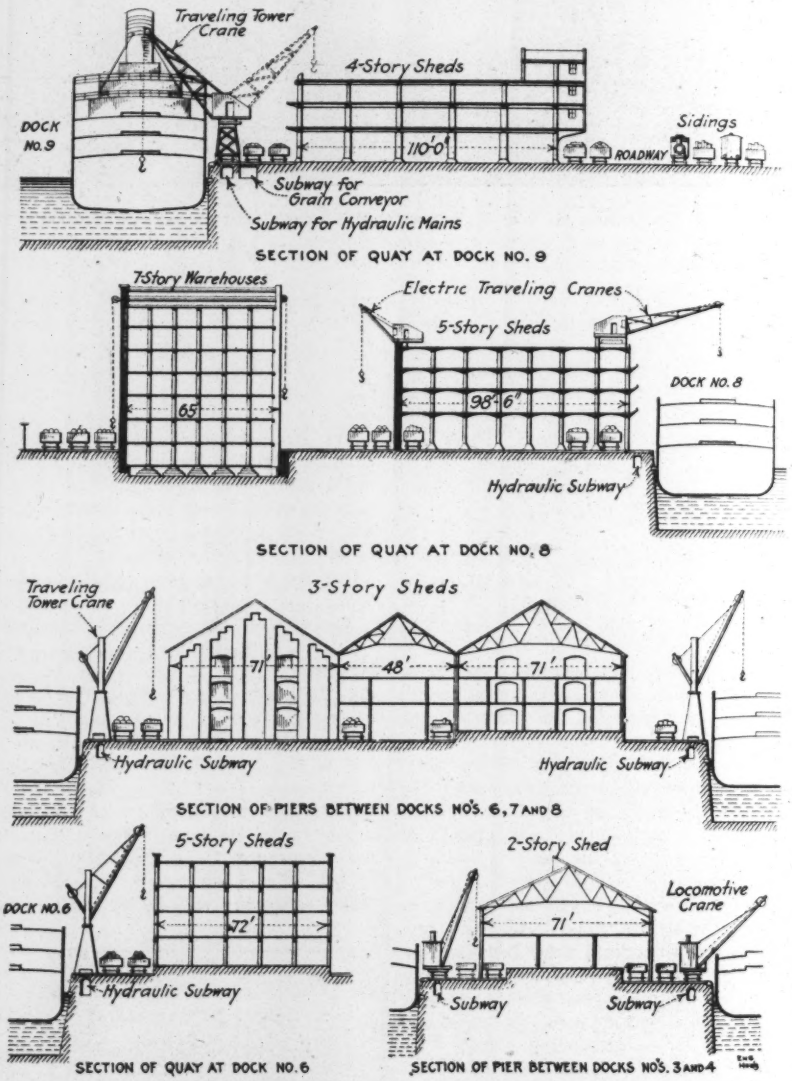


FIG. 5. SECTIONS OF PIERS AND SHEDS AT THE MANCHESTER DOCKS, SHOWING THE ARRANGEMENT OF CRANES AND TRACKS

have a capacity of 200 tons per hour. For drawing the grain to the elevator leg from distant parts of the hold a power shovel is used, which was designed specially for this plant.

MISCELLANEOUS FACILITIES—Extensive facilities are provided for the landing and slaughtering of imported cattle; also stock yards for cattle from coasting steamers, the animals being either loaded into railway cars or driven by road to neighboring markets. There are cold-storage buildings also for frozen meat and for fruit and perishable goods. A large area is provided for the storage of timber (in the open and under sheds), and imports of nearly 400,000 tons were discharged here during 1911. The various oil interests have accommodation for the storage of about 27,000,000 gal. of oil, which can be pumped direct from vessels to the storage tanks. Other facilities are provided along the canal, as noted below.

FIG. 6. GRAIN ELEVATOR, WITH MARINE LEG AND CONVEYOR GALLERIES; MANCHESTER DOCKS

(Copyright, R. Banks, Manchester, England.)

RAILWAYS—The railway system of the docks has been planned with great care as a part of the freight-handling equipment. The tracks run along the quays and into the sheds, so that freight can be handled directly by cranes between cars and ships or between cars and sheds. There is ample trackage, including 80 miles of storage and classification yards, so that complete trains may be made up at the docks for delivery to the various railway companies. The total mileage, including tracks at different points along the canal, is 137 miles. Six trunk lines enter the city and are connected with the docks, and there are railway connections also at points along the canal. The docks railways form part of the property of the Manchester Ship Canal Co., and the company has its own equipment of 50 locomotives and 1400 freight cars, so that it is not dependent upon the railway companies for the supply of cars to insure prompt forwarding of freight or for the handling of freight locally. This arrangement also insures a minimum of cost and handling in the freight service. For moving freight about the harbor there are six pontoons of 800 tons carrying capacity.

SHIP REPAIRS—Just inside the entrance to the docks is the plant of the Manchester Dry Docks Co. This has two dry docks, 535x65 ft. and 425x65 ft., and a pontoon or floating dock 300x70 ft. of 2500 tons lifting capacity. Near the mouth of the canal the company has a similar floating dock.

FACILITIES ALONG THE CANAL

The canal itself serves as a dock at certain points, being provided with mooring places, wharves, coaling plants, passing places and turning basins. Some of these are shown in Figs. 1 and 7. At Eastham, just inside the entrance locks, is a widened portion of the canal (or lay-by) 1500 ft. long, with a depth of 28 ft. alongside the wharf. This is provided with electrically operated sheer-legs or masting sheers for handling the masts of ships which require these to be adjusted before and after passing through the canal. These are capable of lifting 15 tons to a height of 105 ft. above water level at a distance of 30 ft. 6 in. from the face of the wharf. At Ellesmere Port (3 miles) are railway wharves and 1150 ft. of berthage for ships; also shipbuilding and repair yards of the Manchester Dry Docks Co., with a pontoon floating dock, 350x70 ft., capable of taking vessels of 16 ft. draft and 2500 tons weight. At Runcorn (12 miles) is a second lay-by 1500 ft. long, with 28 ft. of water, equipped with a coaling plant, movable cranes and other cargo-handling appliances. Large sailing vessels which cannot pass the bridges even with topmasts lowered, are berthed here; the cargoes are discharged into lighters which are towed to Manchester. Here also the ship-canal company has docks with 15 acres of water area, equipped with hydraulic and floating cranes, coaling plant, railway sidings, etc. At Acton Grange (17½ miles) is a private company's coaling plant, with a 40-ft. wharf 350 ft. long and 22 ft. of water.

At Warrington (18½ miles) the canal company has a wharf where ships can discharge and load cargo; this is 300 ft. long, with 26 ft. of water, and is equipped with a steam crane and a hydraulic transporter (or portable telfer bridge), each of 3500 lb. capacity. At Partington (27 miles) there is a coaling basin of 6½ acres, with quay space of 20 acres and nearly ¼ mile of water front, besides over 20 miles of railway sidings. The coal is received on tracks on the bank, but not high enough for discharge into vessels by gravity, so that the cars are raised and dumped by hydraulic machinery. There are six coaling plants (with space provided for one more), each capable of delivering 300 tons per hour. The machinery is operated by hydraulic power. This coaling station is shown in Figs. 7 and 8. At Irwell Park (31½ miles), is a wharf 1000 ft. long (28 ft. of water) for unloading timber. Near here also are the wharves and tanks of several oil companies, with an aggregate storage capacity of 27,000,000 gal. The oil can be pumped through pipes from ships to the tanks, whence it is delivered to tank

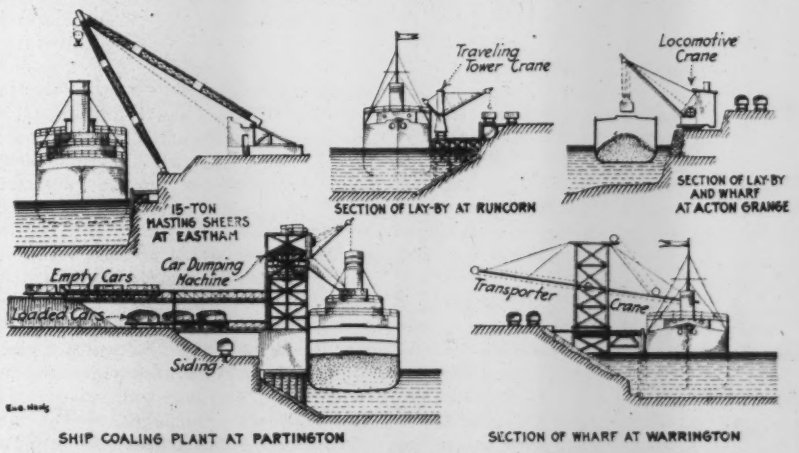


FIG. 7. COALING AND FREIGHT-HANDLING FACILITIES ALONG THE MANCHESTER SHIP CANAL

cars, barges or tank wagons for distribution.

From this point to the docks entrance there are several extensive facilities. First come the cattle wharves and stock yards for the coastwise trade, the cattle being loaded into railway cars or driven to an adjacent market. Beyond this is the wharf for imported cattle, this being 800 ft. long, with an area of 12 acres. It is within two miles of the city slaughter houses, and has extensive railway connections. There is accommodation for 2000 cattle and 1500 sheep, and this can be increased to 3000 of each. Refrigerating machinery, hydraulic elevators and electric lights are provided, and work is done by day or night as required. Between the two stock yards are the city's cold-storage plant, and a private cold-storage plant built specially for the Australian frozen-meat trade.

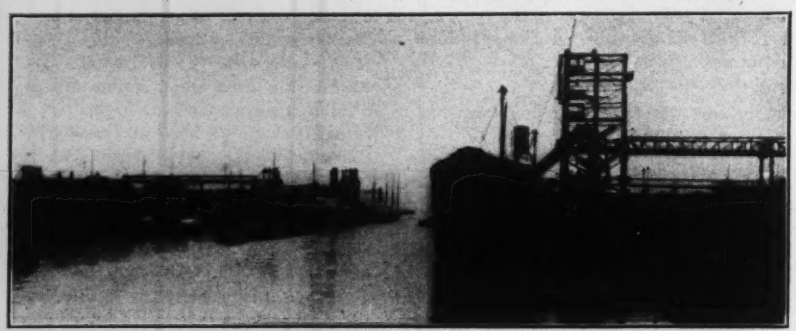


FIG. 8. COALING STATION FOR STEAMERS AT PARTINGTON, ON THE MANCHESTER SHIP CANAL

(There are several car-dumping machines at this point.)

SHIPPING AND COMMERCE

Many large steamship companies now operate lines from Manchester and these regular lines (in addition to tramp and miscellaneous steamers) include services to all parts of the world. There are also numerous coasting lines, and lines to various European ports. The commercial interests of the city recognized the difficulty of changing established trade routes and of inducing steamship companies and shippers to adopt new routes. To facilitate the development of the commerce of this new port a steamship company was organized under the name of the Manchester Liners, which now has nearly a score of steamers and operates regular lines to American, Canadian, Oriental and other ports in addition to a general or "tramp" service. Of course, with such trade routes once established, other shipping companies followed. The largest boats of the Manchester Liners are 452 ft. long, 52 ft. beam and 28 ft. deep, with a register tonnage of 3635 net and 5657 gross. All these carry the name of the port, such as the "Manchester Merchant," "Manchester Engineer," etc.

The largest ships to use the canal are the twin-screw steamers "Argyllshire," "Shropshire" and "Wiltshire" of the Federal-Houlder-Shire Line, trading to Australia. These were put in service in 1911. They are 547 ft. long, 62 ft. beam, 33½ ft. deep, 19,300 tons displacement, with a deadweight carrying capacity of 12,500 tons, and a register tonnage of 6610 tons net or 10,391 tons gross. The engines are of 5500 hp., giving a sea speed of 13½ knots. To clear the bridges these vessels have telescoping funnels and masts.

Many of the large ships in the Manchester trade far exceed the 75 ft. height of the fixed bridges and must lower their masts and sometimes their funnels, for which work masting sheers are provided at Eastham, as mentioned already. However, several large steamers built for the Manchester service are designed with a special view to facilitating this work, and in fact some of them have telescoping masts and funnels (the top section of the latter being lowered) which are operated by the ship's own winches, thus avoiding the delay of laying-up at the sheer-legs, already mentioned.

The canal company acquired about 4000 acres of land for its canal and docks, and had a surplus of about 2500 acres after allowing for its own requirements. To obtain a revenue from this land and also to provide traffic for the canal, the company has adopted the policy of selling or leasing land for manufacturing and industrial works, which have thus the advantages of direct railway and shipping connections. The works already established on the company's surplus lands thus sold or leased include dry-docks and ship-repair yards, stock yards and cold-storage houses for meat, warehouses, timber yards, smelting works, blast furnaces and steel works, flour mills, salt works, soap and candle works, oil storage, and a coaling station, oil refineries and seed-crushing plants for producing oil from cottonseed, linseed and the soya bean. These plants are located at different points along the canal.

An important industrial development which is independent of but closely related to the canal enterprise, is the Trafford Park Estate; this is adjacent to the canal property and is the site of many large manufacturing plants. This industrial district, which is of a novel character, is described elsewhere in this issue.

IMPROVEMENTS AND DEVELOPMENTS

In regard to the development of the port, and the extensive and costly improvements and additional works that have been undertaken since the opening of the canal, we quote the following from the address of Mr. Bythell, President of the Manchester Ship Canal Co., at the company's regular meeting in February, 1911.

"You do not get new lines of steamers the first time of asking; the negotiations sometimes extend over years before you are successful. When the ship canal was opened, and Manchester became a port, we had no merchants here who were prepared to buy cargo after cargo of produce and distribute it, and it has not been a matter of a day or two to persuade importing merchants to come here and begin operations on a large scale.

"I am convinced that the very large amount of traffic necessary to compensate for the low charges forced upon us by competition will eventually be obtained, provided we are able to cope with it efficiently as each increase comes round. This means (and, of course, has meant in the past) continued capital expenditures. There is no doubt that if this policy had not been adopted the undertaking would be moribund today, for we would not have been able to cope with the traffic, and I do not think we would have been making more than working expenses, instead of making about $1,500,000 working profit. Not any of the large expenditure that has hitherto been sanctioned and incurred has been a mistake. As an illustration let me cite two things: If we had not deepened the canal from 26 ft. to 28 ft. (at considerable expense) a large amount of the valuable traffic we are getting would not have been secured because the ships would not have been able to come up the canal, for we have to face the fact that ships are increasing in size. And if we had not had the new No. 9 dock, with nearly half a mile of freight sheds, by no possibility could the traffic during the last three crowded months have been worked.

"We must be able to cope with the traffic when it comes, and the mere fact that we had rather too much accommodation for nine months would not have excused our being unable to accommodate the traffic properly during the three months when it did come. Low charges will never reconcile merchants or shipowners to inefficient working. I have referred to this important question to

emphasize the fact that continued large expansion of traffic must mean continued accommodation."

OFFICERS

The principal officers of the Manchester Ship Canal Co. are as follows: Chairman, John K. Bythell; Vice-Chairman (representing the city), Sir Wm. H Vaudrey; General Superintendent, Ernest Latimer; Chief Traffic Superintendent, Herbert M. Gibson; Chief Engineer, H. A. Reed; Mechanical Engineer, Wm. Fox; Consulting Engineer, W. Henry Hunter.

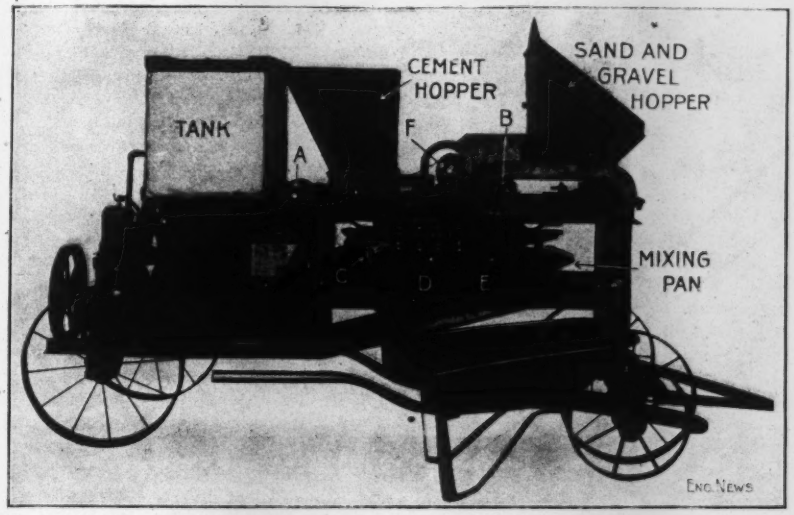
A Concrete Mixer of a New Type

A new type of concrete mixer now being introduced has three special features: 1, it is adapted to small jobs, thus reducing the labor cost on much work where hand mixing is employed; 2, it employs the continuous instead of the batch-mixing process; 3, it does the mixing in a horizontal revolving pan, a method which it is said has not been used previously in concrete mixers. It is stated further that this pan-mixing process removes objections raised against insufficient mixing in continuous mixers, as it allows a thorough mixture to be secured in a small machine; this is due to the length of the spiral path traveled by the materials in passing from the feed point to the discharge point. In addition to this, the workmen cannot shorten the process in a desire for haste, as the concrete cannot be discharged until it has had the prescribed amount of mixing. We are informed that samples of the concrete which have been allowed to set and have been ground on an emery wheel show a very uniform mixture.

The machine is portable, as shown in the accompanying cut, and its weight complete is about 1500 lb. It has a frame built up of steel channels and angles, and is mounted upon four wheels (19 in. and 24 in. diameter), with a wheelbase of about 6 ft. At the rear is a gasoline engine of 3 hp., entirely inclosed (but in the view the casing is removed), and above this are the tanks for gasoline and water. On top of the frame, forward of the tanks, are two hoppers, one for cement and the other for sand and gravel. Separate hoppers for gravel (or stone) and sand can be fitted when required. The materials are measured and fed automatically, the proportion of cement to aggregate being varied by the use of sprocket wheels of different diameters on the shafts which drive the two feeding mechanisms, *A* and *B*.

The materials are fed to a horizontal revolving pan, about 3 ft. diameter, placed between the upper and lower members of the frame. The sand and gravel are delivered from their hopper to the center of the mixing pan, and the cement is delivered above the sand and gravel. Within the pan is a stationary spider whose radial arms carry ten fixed plows (one of which appears at *C*), so placed as not only to mix the materials in the revolving pan, but also to guide them in an approximately spiral path, gradually working from the center to the circumference. The four outer plows throw the material back toward the center so that the material encounters each plow several times. Water from four pipes, at *D*, is fed continuously to the outer part of the pan, so that the contents are first mixed while dry and then enter the wet zone. A special discharge plow *E*, near the circumference is so arranged as to continuously discharge a portion of the mixed concrete over the edge of the pan, where it is received by wheelbarrows or by a chute for direct delivery to the forms.

The mixing pan is driven by a bevel gear on the bottom and a bevel pinion on the engine shaft. The same bevel gear drives the central vertical shaft, on top of which is another bevel-gear drive to a cross-shaft carrying sprocket wheels, *F*, for chains which operate the revolving measuring and feeding devices, *A* and *B*, on the two hoppers. The mixer has a nominal capacity of 6 cu.yd. per hour, but it has been run at larger capacity. It has been used on sidewalk and small foundation work, and its light weight makes it specially suitable for small jobs as it can be moved readily from place to place, and kept close to the forms, so as to greatly reduce the amount of handling of the concrete. This machine is manufactured by the Aurora Concrete Mixer Co., of Aurora, Ill.



THE AURORA CONTINUOUS CONCRETE MIXER, OF THE REVOLVING PAN TYPE
(Aurora Concrete Mixer Co., Aurora, Ill., Maker).

Transmission-line Franchises—A recent Prussian government order (issued by the Minister of the Interior, the Minister of Commerce, the Minister of Public Works, and the Minister of Agriculture and Forests) takes a strong attitude against the grant of exclusive franchises or perpetual franchises to electric transmission-line interests. The order in substance is as follows:

In making agreements with the promoters of electric transmission lines as to the use of public streets, roads and places, for transmission lines or for transformers and other apparatus, communities frequently obligate themselves to refrain from granting similar rights to other applicants during a specified period of time. The tendency of development seems to be toward the undertaking of production and distribution of electrical energy by large public or communal organizations or associations. Exclusive franchises granted to private interests may set up obstacles which either cannot be removed or can be removed only with great sacrifices. Moreover, the future development of electric power service cannot yet be foreseen fully. The cost of current in general shows a lowering tendency. For these reasons communities are advised not to accede to the demands for promoters for exclusive franchises, but to take advantage of the benefits of competition. Should an exclusive franchise be unavoidable, it should in any case be granted only for the shortest possible period; frequently, only a few years of protection suffice to place the undertaking on an assured basis. Further, the scope of the exclusive franchise should be restricted as far as possible; as the purpose of such a grant requires it to cover the transmission of electric power current only, gas or signaling current lines should not be included. Exceptions should also be made in favor of transmission lines for transportation service and for operating and lighting all plants connected therewith. Finally, special care should be taken that communities never divest themselves of the right to grant permits for the through-transmission of current for delivery in other distributing areas.

Notes on the Operation of the Cement Gun

By Otto J. Swensson*

As inspector for the Board of Water Supply of New York City on the Hunters' Brook Siphon, at Yorktown Heights, N. Y., in the summer of 1911, the author had a splendid chance to observe the workings of the cement gun and its product on a large and difficult piece of work. At this location, a steel siphon,† under about 100 ft. head, was built and covered on the outside with concrete and lined on the inside with cement mortar placed with the cement gun. This siphon is 1500 ft. long, 9 ft. 9 in. in diameter, composed of riveted-lap steel pipe $\frac{7}{16}$ in. thick, covered with a horseshoe-shape concrete envelope 6 in. thick on top and 2 ft. thick at the thickest place on the sides where it joins the invert. The mortar lining is of a minimum thickness of 2 in. and a maximum of $2\frac{7}{16}$ in., this difference of thickness being due to the lapping of the steel sheets. The pipe came from the shop in 15-ft. lengths, being made up of two 7½-ft. courses.

The information given in this article has been collected from personal experience, from conversations with men connected with cement-gun work and the study of a series of tests of the gun product made by a reliable engineering company.

The cement gun may be briefly described as a hopper into which sand and cement is mixed dry to be blown by compressed air out through a nozzle, where it unites with a spray of water to make a concrete mortar. The materials for the gun are thoroughly mixed dry and then passed over a ¼-in. screen to remove all larger objects which are liable to clog the feed hose. In dealing with cement it is a well known chemical fact that the instant water touches it the chemical combination or initial set begins. It is seen that further working, whether by hand or machine work, tends to deteriorate the product. By using the gun this extra working is done away with to a very great extent, as the hydration, or mixing with water, takes place in transit from the nozzle to the placing so that the chemical action occurs on the surface where the product is wanted, without further handling.

When the first gun was taken to the Hunters' Brook Siphon it was mounted on a horse-drawn truck, together with the gas engine and air compressor. The next gun was a newer model mounted on a hand-drawn truck with the air compressor stationary. This gun was used to demonstrate the workings and product, and after approval, the cement-gun people started to work on the siphon lining with two guns of the newest model, which was a big improvement over the other model. This last gun is the one described herein and the product is known as "gunite."

*Office of Commissioner of Public Works, Borough of Manhattan, New York City.

†A general description of these siphons appeared in Engineering News, Nov. 2, 1911, p. 526.

Description of the Cement Gun

Fig. 3 is a sketch showing the principi- filled with dust a current of compressed dry cementitious materials is dumped into upper chamber *A* through the swinging gate *C*, which works against a rubber gasket. Chamber *B* is separated from *A* by a similar swinging gate *D* and gasket. In the lower parts of *A* and *B* are vertically revolving agitators *P*, which are operated by hand. These perform the operation of breaking up any lumps of the dry mixture of cement and sand which might either be overlooked by the charger or formed after the materials had been placed in *A*.

The feed or discharge apparatus is a very ingenious and interesting part of the gun. At the very bottom of *B* below *P* is the main agitator or feed wheel *L*, which is operated by an air motor, as will be explained later. This wheel is a solid circular cast-steel plate about 1 in. thick with a socketed edge, so that the whole thing is really a cog wheel. The pockets in the edge formed by these ser-

rations carry the dry mixture in ra- intermittent charges over the "blow-p- *I* and its charge of compressed air, thus the mixture is blown upward and out- ward through the goose neck *H* into the flexible hose on the end of which is the nozzle (Fig. 2), the explanation of w- ch follows later. The driving air enters through the pipe *S*.

Operation of Cement Gun

The gun is operated as follows: the gate *C* is open with gate *D* closed, at which time it is possible to run the air through *B* to test out the hose and nozzle, at the same time pouring a charge of the dry mixture in *A*. The gate *C* is now closed and the threeway valve *O* in the equalizing pipe opened, letting the compressed air into *A*. In a short time the air pressure will hold *C* closed; a few seconds after this the pressure in *A* equals the pressure in *B*, and the gate *D*, which has been held in place by the air pressure, opens automatically, due to the weight of the charge on the top and the equal air pressure on both sides, permitting the charge in *A* to fall into *B*. Next the gate *D* is closed by hand and the air exhausted from *A*, when the gate *C* opens by its own weight. The air in *A* only has the duty of keeping *C* closed so that the pressure in *B* remains constant, assuring a uniform discharge from the feed hose.

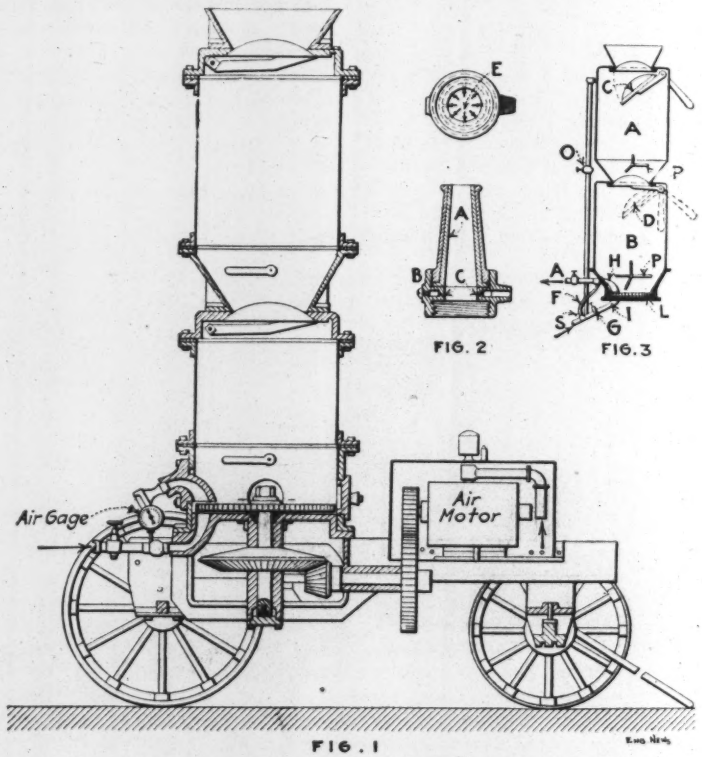


Fig. 1. Cement Gun, Mounted on Carriage
Fig. 2. Detail of Nozzle for Cement Gun
Fig. 3. Section through Cement Gun

The gun is now ready for another charge of dry mixture.

The feed wheel *L* revolves on a center vertical shaft and is propelled by a small air driven motor, direct-connected by cogs. As this wheel revolves, it carries a small amount of the dry mixture at a time directly into the main compressed-air current. *I* and *H* are hooded so that the current carries directly from the former to the latter, picking up the small charge of materials on the way. The output of the gun depends upon the speed of *L*, and this can be governed by a valve on the supply side of the air motor. Thus it is that the gun has a continuous feed, and is, therefore, continuous at the nozzle. To stop the stream of materials, simply shut *G* and the air to the motor. The bypass *F* and its valve is used to blow out the hose if it should clog. The air for shooting is admitted at *S* and on this line just beyond *G* is an air-pressure gage. The feed hose with the dry materials leads off from *R* to the nozzle.

The nozzle, Fig. 2, is of particular interest, as it is there the dry mixture first comes in contact with the water for hydration. The water under ordinary city pressure or about 35 lb. per sq.in. is delivered to the nozzle through a ½-in. flexible hose, which is entirely separate from the feed hose. At the larger end of the nozzle is a water sleeve *B*, completely around it, so that the water enters as a fine spray from eight ⅛-in. holes at *C*, from all sides impinging toward the center. The amount of water used is regulated by a valve at the nozzle. At first a great deal of trouble arose due to the wearing out, by the abrasive action of the sand and cement, of the smaller end of the nozzle, so now a rubber lining *A* is used, which holds up better than any substance yet tried.

The materials, in a wet state, leave the nozzle at about the rate of 300 ft. per sec. From this fact the "gunite" is far denser than hand-applied, also of a greater tensile strength. A test which helps to bear this out was made. One ton of cement mortar applied by hand covered 25 sq.yd., 1 in. thick, while the gun covered only 16½ sq.yd. 1 in. thick.

Operation on Siphon

The charge of dry materials on the Hunters' Brook lining was two buckets (coal hods), or 1080 cu.in. per charge. The volume for 1 lin.ft. of the 2-in. lining equals 5.2 cu.ft., and for the 2⅞-in. lining, 6.12 cu.ft. The bottom, or invert, excluding the first 175 ft., was placed by hand. As the "gunite" was shot on with so great a force, a small quantity of sand, which we will term the excess, bounced off until the steel sheet received a coating of cement. The small amount bounding off after this had no cement adhering to it. To allow for this excess the proportion of sand was increased one-half portion, or about 14%, so the proportions of the dry mixture were 1 cement to 2½ sand, which gave 1 part cement to 2 parts sand for the lining, as required.

The siphon had been under hydraulic test while the concrete envelope was being placed; it then was drained, the bulkheads removed and left idle through the three cold months. This caused considerable fine rust on the inside of the pipe, which had to be removed before placing the lining. This was done by first scraping with heavy short handled scrapers, then brushed thoroughly with wire brushes, finally wiped down with old sacks. Better results were obtained with brushes having short wires, as they cut the rust better than the long wires, which are more flexible. When a stretch of about 75 ft. had been efficiently cleaned, the gun was brought into play, to wash down the pipe with a stream of water combined with compressed air.

The next operation was to put a "spray coat" of a very wet "gunite" on the cleaned pipe. This coat was only about ⅛ in. thick and simply for the purpose of keeping the pipe from rusting until the lining was placed. The pipe being of alternate inside and outside courses, to facilitate the screeding, it was decided to complete the lining of alternate courses in a stretch before shooting on the intermediate courses. For this reason the "spray coat" was scraped off while it was wet, in an 8-in. band from the extreme ends of the intermediates.

The screed for the alternates was pine board 4 in. high, 1 in. thick and 8 ft. long. On the ends were wooden blocks of the proper height to give the required thickness of lining, and along the face of the screed was a strip of thin sheet steel. For the intermediates the blocks were left off and the ends of the screed rested on the hard finished face of the alternates. The screed was the only form of any kind that was used even at the man-hole and blow-off connections.

After the "spray coat" came the first coat, which was from ½ in. to ¾ in. thick, placed successively on three or four alternates. By following this procedure, the "gunite" had partially set up on the first alternate by the time the first coat had been shot on the third or fourth. Then another coat was put on alternate number one, making the thickness about 1¾ in. The same operation was followed on the remainder of the alternates. The screed was run over the courses to see that the thickness was about even. Following this came the final coat in the same order as before. As soon as this was shot, the screed was used to ascertain that the proper thickness was on and that there were no depressions. In case there were holes the gun filled them and then screeded, making all ready for the floating and flat troweling of the finished surface. The other three or four were filled in before the gun was used on the remainder of alternates of the stretch. The screeding was done by moving the screed back and forth with the length of the pipe, at the same time working it around the circumference. The intermediates were worked in like manner until the stretch was finished, then another stretch started. If a part of the lining fell off before it set, the gun built the cavity up and bonded it in very efficiently with the rest of the lining.

The invert, placed by hand to a chord width of 7 ft., had to be finished with clean, sharp edges on the ends and sides. The hand-worked invert was placed before the rest of the lining of the siphon, all except about 75 ft. Because of the invert being placed first, care had to be used to guard against sand pockets. These pockets were liable to form by the particles of sand dropping off when the lining was shot, lodging on the sides of the invert against the pipe, then shot over before being removed by hand.

The final coat of the "gunite" required but very little floating and troweling to give a good surface. The finished surface was very smooth and free from all marks. After setting up and drying out, some hair cracks were found which were probably due to shrinkage or maybe expansion or contraction, as the pipe was protected by only the concrete envelope and by backfilling about up to the level of the horizontal diameter. The lining was placed during the hottest part of the summer. The ventilation was obtained through the open ends of the pipe, a 2-ft. manhole about half way between the ends and by 2-in. plug holes in the top every 15 ft. When the air became too foul or filled with dust a current of compressed air was turned on until it cleared. The light was furnished by four large track gasoline vapor lamps. Later on electricity was tried.

The compressors used were as follows: one high-pressure compressor, mounted as a horse-drawn truck, with gasoline engine. The compressor furnished 105 cu.ft. of free air per min. Combined with this was a storage tank and an automatic unloader. This unit used about 25 gal. of gasoline per day of eight hours. Connected with unit No. 1 were two other engines and compressors of the same make, but with a compressor giving 110 cu.ft. free air per min., having an automatic unloader. Each of these used about 20 gal. of gasoline per 8-hr. day. The water for cooling the jackets and for the "gunite" was pumped directly from the brook with a vertical gasoline engine and pump combined, using about 6 gal. of gasoline per 8-hr. day.

The cleaning of rust from the pipe was done by a foreman and five laborers, which was part of the main contract, while the lining was a sub-contract. For the operation of the gun and all work connected with the lining the force account consisted of superintendent, time-

keeper, operator of gun, 4 plasterers, 2 mechanics, 8 laborers, 2 nozzlemen, a team and driver. All this force worked eight hours per day for six days a week.

Conclusions

The following observations are for one month, with an 8-hr. working day. It was intended to use two guns at the same time, at different parts of the work, every day. This was impossible, on account of the low water and air pressure, so each gun was used part of the day. The smallest number of charges in any one day was 132, or about 83 cu.ft. of dry mixture; the largest number was 600, or about 375 cu.ft., and the average was 199, or about 125 cu.ft. To get the amount sticking to the surface it is necessary to deduct 14% in each case, getting about 71, 322 and 107 cu.ft.

The cement gun is a new invention and since it was first used has been improved greatly. The methods of using "gunite" have also advanced. As these developments increase, the cost of placing "gunite" will be decreased materially. In the writer's opinion the completed lining should have been sprayed with water two or three times a day for two weeks, thus preventing shrinkage cracks. Another safeguard against cracks would have been to have the backfilling over the siphon, to reduce the effects of expansion. Even yet it is only in its infancy and there is much to be learned about it and "gunite." Already the gun has been used in many kinds of work, the lining for the steel-pipe siphon, coating structural members of the new Grand Central Depot in New York City, sealing rock surface in Panama and Jersey City; the Baltimore, Md., sewer; sea wall at [illegible]n, Mass.; building houses, coating old houses and many other places.

The conclusions to be drawn from the series of tests made by the private engineering firm referred to at the beginning of the article are as follows:

For tensile strength, "gunite" was from 20% to 25% better than the hand work.

For compressive strength, the "gunite" was from 20% to 70% better than hand work.

For permeability, the "gunite" absorbed 5% to 70% as much water per hour per unit of area as hand work.

For absorption of water, the hand work took up from one to five times as much.

For percentage of voids, the "gunite" was 50% to 75% of the hand work.

For adhesion, the "gunite" was on an average 25% better than hand work.

The Federal Water-Power Policy

By M. O. Leighton*

The author believes that engineers should give quiet study to the federal-government policy in regard to the development of water powers needed. He has outlined the outgrowth of the present regulations, showing that desire to control did not first arise where the government possessed a proprietary right, as in the public lands, but appeared in national grants of water-power privileges on navigable streams, where more conditions were imposed than were essential to the protection of navigation. In reply to the criticism that present federal regulation is a bureaucratic assumption of power under no federal law, he states that the precedents were deliberately established by Congress under its interpretation of the Constitution.

*Chief Hydrographer, U. S. Geological Survey, Washington, D. C.

The Basis of Federal Regulation

Much has been said and written on the attitude of the federal government with respect to water-power development. It is, therefore, unfortunate that so large a number of engineers are either uninformed or grossly misinformed on the subject. There is much yet to be done in the final shaping of a federal policy and the wisdom and expediency thereof will, or should be, largely dependent on the coöperation and counsel that engineers give to our law makers. This paper will explain certain features of policy and summarize a new set of regulations adopted by the Secretary of the Interior a few weeks since.

The federal government intervenes in water-power matters because of two circumstances. The first is the possession of sovereign authority over the use of certain rivers for navigation purposes. The second is the proprietorship of certain lands in the West on which there are water-power privileges. Authority in the first is vested in the War Department; that in the second is in the departments of the Interior and of Agriculture. Rarely has the War Department been involved with that of the Interior in the administration of matters with respect to the same site, though it is probable that such cases will be more common in the future.

It is conventionally assumed that the government's authority over navigable streams is limited to the improvement and maintenance thereof for navigation purposes. This automatically carries the authority to forbid or to regulate the erection of structures that are or that may become obstructions to interstate commerce. Some legal authorities contend that a broader power than this is conveyed by the Constitution. Whether or not this be true is not of importance in this immediate discussion. The fact is significant that in recent years Congress has by statute, assumed more authority over water-power development in navigable streams than it formerly exercised. It used to be the legislative habit freely to grant authority for such development, reserving only the right to provide that the structures shall in no way obstruct the passage of floating commerce. More recently, advantage has been taken of an established legal principle that the power to grant a thing carries therewith the right to attach conditions and stipulations to the grant. Inasmuch as the permission of the United States is necessary before a power plant may be erected on a navigable stream, it is possible for the government to withhold that permission until the applicant shall consent to certain stipulations, which perchance the government might not possess direct authority to enforce. The last "general dam act," approved June 23, 1910, clearly indicates the trend of legislation when compared with earlier ones. Among the requirements that indicate a disposition to exercise authority beyond that necessary for the mere protection of navigation are: (1) all the plans, including those of purely water-power appurtenance, are subject to the approval of the War Department; (2) the projector must convey to the United States title to lands required for constructions and approaches made for navigation purposes and must furnish free power for building and operating such constructions; (3) in acting upon such plans, the War Department shall consider the bearing of such structures upon a comprehensive plan for the improvement of the waterway over which it is to be constructed, with a view to the promotion of its navigable quality and for a full development of the water power; and as a part of the conditions and stipulations, shall provide for improving and developing navigation, and fix such charge or charges for the privilege granted as may be sufficient to restore conditions with respect to navigability as existing at the time such privilege be granted; (4) the War Department is authorized and directed to fix and collect just and proper charges for the

privilege granted to all dams authorized and constructed which shall receive any direct benefit from the construction, operation, and maintenance by the United States of storage reservoirs at the headwaters of any navigable streams, or for the holding and maintenance of any forest or other lands for the development, improvement, or preservation of navigation; (5) Congress may revoke any rights conferred whenever necessary for public use, with payment of suitable indemnity, and any authority granted under the act shall terminate at the end of the period not to exceed 50 years, unless sooner revoked.

Several "special dam acts" have been vetoed by Presidents of the United States because they do not provide for the payment of fees for the privileges conferred, the latest notable veto being that by President Taft, on Aug. 24, 1912, of the bill to authorize the building of a dam by the Alabama Power Co. across Coosa River at the place selected for Lock No. 18. In his veto message, the President stated that when instead of building the dam itself, the United States builds it through an agent, as proposed in the bill, it was clear that the dam and all its incidents, including the water-power created, is within the regulative power of the federal government in respect to navigation. He held that while the Alabama Power Co. is entitled to be credited for all necessary expenditures in the investment, "it is equally manifest that in the course of time the return from the privilege in the shape of valuable water power created, may far exceed the reasonable return for these items." The failure of the bill to provide for compensation to the government was regarded by the President as a fatal defect. The President further said, "I deem it highly important that the nation should adopt a consistent and harmonious policy of treatment of these water-power projects which will preserve for this purpose their value to the government whose right it is to grant the permit."

All of the foregoing provisions and comments are clearly the result of the belief that those who make use of public property shall do so under certain conditions and with acknowledgment of certain reasonable obligations to the public. The trend of argument with respect to the control of public utilities is too familiar to require review in this paper, and the matter is touched upon merely to emphasize an important fact, viz., that the evidence of a desire on the part of the public to control in matters of water-power development did not first appear in the administration of public-land matters, nor in any case in which the federal government possessed a proprietary right. We find its first appearance, under national auspices, in grants of water-power privileges in navigable streams, where, under the conventional interpretation, the federal government had no physical property to give away and no sovereign authority except to prevent the use of a river channel in a manner prejudicial to navigation.

Some men have claimed that the federal regulation of water-power development on the public lands is merely the bureaucratic exercise of a right of possession, and that no federal law has been enacted with the intent to establish federal control over water power. The fact is that precedents were established by deliberate acts of Congress and under an interpretation of constitutional authority which is by no means uniformly accepted. Of course, these acts do not seek to establish the direct control over maintenance and operation of water powers to the extent that was later exemplified in the administration of national forests. They do, however, prescribe stipulations which are clearly not essential to the mere protection of navigation and which by implication as well as by direct assertion, lay claim to some authority over water-power operation in navigable streams.

The Need for Regulation

Water-power development on the public lands has been attended by abuses of many kinds. It would be profitable to discuss their character and results, were it not that the space required would be too large. Those who wish to pursue this phase of the matter may find the facts in numerous government publications. The point of immediate importance is that the regulation or restriction of public-land power development was prompted by specific abuses and evasions of law as well as by the general necessity for the governmental control of public utilities. Some of the apparent needs may be summarized as follows:

First, the water-power privileges of the public lands should be open for development by those desiring to make immediate use thereof and under such governmental safeguards and assurances, with respect to title and possession, as will attract development capital.

Second, because of the prospective value of these power sites and of their ultimate importance to the whole people, means should be furnished by which they may be held in governmental ownership, developed under a suitable long-term lease that shall contain reasonable provisions for fees or rentals, and at all times be subject to such reasonable control as may be justified by the facts in the case.

Third, the purely speculative phases and opportunities under which easements for power rights-of-way were secured, without intention to develop and with the purpose of holding for sale at a large profit, should be removed.

Legal Foundations

There were many other considerations of importance, but the gist of the most of them is covered by implication in the three preceding paragraphs. What now was the legal basis for establishing such a policy?

The act relating to rights-of-way through certain parks, reservations, and other public lands, approved Feb. 15, 1901, superseding all previous acts with respect to the disposition of power sites and similar rights-of-way on the public lands, authorizes the Secretary of the Interior to issue permits for the use of such lands for the generation and distribution of electric power, and for other similar purposes, such permission to be revocable by him, or his successor, in his discretion and not to be held to confer any right of easement, or interest in, to or over any public land, reservation, or park.

In the absence of further legislative action, it was necessary to utilize this law and to adopt a policy, in conformity therewith, that would approach the ideal as closely as possible. As the federal government owned the land and as the law gave the Secretary of the Interior, and the Secretary of Agriculture in the case of National Forests, wide discretion as to the terms under which the permits might be granted, it was comparatively easy to adopt a procedure which, while it might not do entire justice to the situation, would at least hold the power sites in federal ownership pending the passage of a more comprehensive law.

The first step in the matter was taken by the Department of Agriculture through the Forest Service in 1907, when it was provided that the use of lands within the National Forests for water-power purposes must conform to certain regulations. These regulations have been altered since their first adoption to better suit the needs and conditions. The details are familiar to engineers. Attention is here directed to the fact that the land covered by the regulations is reserved land, i.e., designated and set apart by statute for forest purposes and not subject to entry, settlement, and disposition as is the open or unreserved public land.

The problem with respect to the unreserved lands was different and more difficult. Those possessing water-power privileges were open for acquisition under the well known procedure established by several public-land acts. So long as they remained in such a status, there could be no effective control. Logically, then, the proper course was to designate and "withdraw" such lands "from entry," or in other words, to reserve them, lock them up, or remove from them the application of other laws providing for public-land disposition. This was done, first under general ad-

ministrative authority of the Department of the Interior, and latterly under the authority of the "Withdrawal Act," approved June 25, 1910.

Withdrawals of Public Lands

Few departmental acts and purposes have been more thoroughly misconceived and more effectively misrepresented than those of the government's water-power withdrawals. Those upon whom fell the duty of designating the lands, fully appreciated the difficulties. The two fundamental elements entering into the determination of a power site are flow of water and fall of stream channel. A very fair idea of the flow of many of the larger Western streams had been acquired in previous work of the Geological Survey. That of by far the greater number of the smaller streams was unknown. Similarly, the slope of some of the river channels was known in detail. In others, the information did not exist, or it consisted of a few approximate figures. To cover as many power sites as possible and thereby to prevent the desirable ones from passing into private ownership while suitable surveys and examinations were being made, all the rivers of importance in the West were studied in the light of available data. The public lands along such of these as appeared even remotely feasible was withdrawn from entry. It was fully realized at the time that many thousand acres, withdrawn for power purposes, might prove to have no power value. The intention was to successively examine these tracts and to have restored to entry those which were found valueless. Such examinations have been made as fast as has been possible by means of the appropriations which have been made available for this work. An immense area of land in withdrawal yet remains to be classified. Since the date at which the original withdrawals were made, many other sites have been withdrawn and many thousand acres have been restored to entry after having been found to be without power value. The area so withdrawn, up to Oct. 30, 1912, less that restored after field examination, is 1,825,980 acres.

The engineering criticism that arose because of the withdrawal of so called water-power sites on which there is no water power, is met by the foregoing explanation. Poor selection was an inevitable consequence of the conditions as to time and lack of data. The condition was recognized at the outset, and has been corrected as fast as funds have been made available for examinations. Engineers have also severely criticized many of the withdrawals because of their present lack of feasibility as power sites. It is true that there are thousands of withdrawn acres, the development of which for power purposes would be enormously expensive and the capacity of which would be comparatively small. The sites would also be valueless after development because a suitable market does not exist at present. Such critics should remember that these withdrawals were made for future as well as for present utility. So far as human intelligence can determine, this country will several generations hence be very dependent on water power. In that day, a power privilege that now appears impracticable, will be considered desirable.

The action of the Interior Department has, in few, if any, cases, postponed the actual development of projects that would have been a benefit to the country. By far the greater number of projects, for which rights-of-way have not been granted, were either purely speculative, or impracticable, or encumbered by features that would have prevented them from becoming profitable investments for many years hence. Had they been constructed, they would merely have added their contribution to the burden of worthless power securities which have glutted the market, and the power business would have suffered accordingly. Thus arises an incidental though great benefit.

Comparatively little land withdrawn for power purposes is of value for any other purpose. Especially in the older settled valleys of the West was it found that the only land remaining in public ownership, and therefore available to be withdrawn from entry, was land not suitable for agriculture. It had been passed over by settlers and entrymen as unfit, and can be productively used only for water power. The facts in the case effectively dispose of the oft-repeated contention that the government has locked up for the contingent use for future generations, land that has enormous present values.

The Present Regulations*

How, then, may a water power be developed on the public land? At present, the only possible orderly course is to develop under a revocable permit, provided in the Act of 1901, above referred to. Water-power people have advanced real objections to such a measure. It is claimed, with good reason, that because no easement is granted to any lands, and because the permit is revocable at will by the Secretary, it is difficult or impossible to secure investment capital. They have also held with good reason that a permittee is subject to dispossession, if it should occur that his water-power structures are located on land that is subsequently included in a mineral entry. These, and other conditions, render a water-power investment unstable. The difficulties have been appreciated by the Secretary of the Interior quite as keenly as by the water-power projector. In the absence of constructive action by Congress, he has made an attempt to overcome many of the difficulties and to minimize others by the adoption of a code of regulations governing the acquisition of rights-of-way through the public lands (except National Forests) for water-power purposes. (The regulations within the National Forests remain as heretofore.) The following is a summary of some of the important features of these regulations which were approved Aug. 24, 1912:

(1) A power permit shall, unless sooner revoked by the Secretary, remain in effect 50 years from the date thereof, and the permittee shall have priority over all other applicants in a renewal of the permit if "at any time not less than 2 nor more than 12 years prior to the termination of the permit, the permittee shall formally notify the Secretary that he desires a new permit to occupy and use such lands as are occupied and used under existing permit, and will comply with all then-existing laws and regulations governing the occupancy and use of lands of the United States for power purposes."

The Secretary of the Interior has endeavored in the foregoing regulation to overcome, so far as is legally possible, the disadvantage of a revocable permit. His agreement as to a 50-year term is an administrative one, which may have no standing in law, but which, nevertheless, has at its back all the integrity of the Interior Department. So far as that Department is concerned, the guarantee is as morally binding as though it were a matter of statutory provision. Deliberate default of such an agreement by the Department, in the absence of wrongful behavior by the permittee, would be so obviously against public policy as to make the event a practical impossibility.

Attention is called to the provision in the foregoing regulation, providing for the period previous to the expiration of the permit, during which the permittee may arrange for an extension. This will be appreciated by those who have had to meet the embarrassment that arises with respect to the financing of betterments and extensions in public utilities near the close of a limited-term franchise.

(2) It is provided in the regulations that should the United States dispose of any tract traversed by right-of-way granted under a permit, such disposition shall be subject to that right-of-way until the permit shall have expired, or shall have been revoked. This gives the permittee assurance of undisturbed possession of the property, because it protects his right-of-way from cancellation as a result of the perfection of a legal entry.

(3) Provision is made for the issuance of preliminary permits, which establish and retain priority of the permittee over any other applicant for the same lands

*The regulations of the Forest Service (Department of Agriculture), which are similar to those of the Department of the Interior were outlined in Engineering News, Nov. 7, 1912, p. 844.—Ed.

during a period named in the preliminary permit, within which the permittee may make final surveys, plans, etc., for the eventual construction. Upon proper presentation of these, and in compliance with sundry regulations as to method and form of procedure the applicant may secure a final permit covering a period of 50 years as aforesaid.

(4) Among the definitions of terms, the most of which coincide with those in common use are:

"Total capacity of the power site" means the net power estimated to be available for transmission, and is determined as the continued product of (a) the factor 0.08[1]; (b) the average effective head, in feet; (c) the stream flow estimated to be available at the intake (in cubic feet per second and in amount not to exceed the maximum hydraulic capacity of the project works); and (d) a factor, not less than the average load factor of the power system, representing the degree of practical utilization of the stream flow estimated to be available, and based on the extent of practical forebay storage and the load factor of the power system.

"Rental capacity of the power site" means the capacity on which the rental charges are based, and is determined by making a deduction from the total capacity of the power site which, in per cent., will be the product of the square of the distance of primary transmission in miles and the factor 0.001, but in no case will such deduction exceed 25%.

(5) Rental charges for the use of lands under permit are based on the rated capacity of the power site, the minimum rates being as fololws:

For the unexpired portion of the calendar year and for the first full calendar year of the survey-construction period, and similarly for the operation period	$0.01
For the second full calendar year of each of said periods	0.02
For the third years	0.03
For the fourth year	0.04
For the fifth year	0.05
For the sixth year	0.06
For the seventh year	0.07
For the eighth year	0.08
For the ninth year	0.09
For the tenth and each succeeding year	0.10

The foregoing is the minimum schedule. The rental charge will ordinarily be calculated at ten times the foregoing factors, unless there appears a good cause for fixing a different rate. Municipal power plants are not assessed a rental charge, but such permits will be subject to special conditions, as the Secretary may deem necessary to fully protect the power consumers. All rental charges are subject to revision at intervals of not less than 10 years, but it is specifically provided that the rates shall not be so increased as to reduce the margin of income from the project over estimated and proper expenses to an amount which in view of the circumstances and risks of the enterprise is unreasonably small. But the burden of proof of such unreasonableness shall rest upon the permittee.

(6) The issuance of a final power permit after the applicant has complied with sundry regulations as to procedure and presentation is contingent upon his agreement to do many things, the most important of which are: (a) to construct the works according to the approved specifications and to complete the same within a specified period; (b) to begin operation at a time specified, and to operate continuously unless prevented by unavoidable contingencies; (c) to install and maintain measuring devices for the determination of water supply, energy developed and transmitted, and to report the results thereof annually; (d) to open the books and records at all times to the inspection of the Secretary, or his agent; (e) to sell power to the United States at a rate as low as that given for any other purchaser for like use; (f) to maintain a system of accounting for the entire power business, and where local laws do not require any particular form, in such manner as may be required by the Secretary; (g) to abide by such reasonable regulations of service and rates of payment by consumers as may from time to time be prescribed by the state, or any designated agency of the state in which the service is rendered; (h) to avoid such transfers of ownership, possession, or control, that will result in the formation of an unlawful trust, or subject the plant to any unlawful contract or conspiracy to limit the output of electrical energy, etc.; (i) to transfer upon demand of the Secretary the plant and appurtenant properties, including transmission lines to any state or municipal corporation, designated by the secretary on condition that the permittee shall be paid the replacement value of the property, plus a bonus equal to ¼ of 1% of said value for each year of the unexpired term of the permit, said value to be determined by mutual agreement between the parties in interest, and in case they can not agree, by th Secretary.

It is provided that a final permit may be transferred to a new permittee under the following conditions, and not otherwise: The transferee shall file with the Director of the Geological Survey a written instrument upon which the proposed transfer is based; also an application in the form of an agreement, binding him to the performance of such new and additional conditions as the Secretary may deem necessary. The Secretary may thereupon, in his discretion, approve the proposed transfer, after which the transferee shall succeed to all the rights and obligations of the permittee subject, however, to such new and additional conditions as shall have been embodied in such agreement, and so approved.

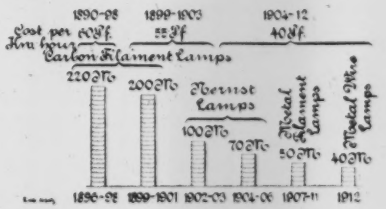
Violation by the final permittee of any of the provisions of the regulations shall be sufficient ground for revocation of the permit.

[1]The factor 0.08 represents the horsepower at 70% efficiency of 1 cu.ft. per sec. of water falling through a head of 1 ft.

The Reduction in the Cost of Electric Lighting Abroad

An interesting and significant diagram is printed in the *Allgemeine Electricitats Geselleschaft Journal* for October, showing the annual cost of electric lighting in an average four-room dwelling in Berlin, Germany, during the period 1896-1912.

It is stated that the prevailing price for current of the Berlin Electricity Supply Works is taken and it is assumed that



ANNUAL COSTS FOR LIGHTING A FOUR-ROOM BERLIN DWELLING FROM 1896 TO 1912

the householder is using the most modern form of electric lamp available at each period. In reproducing the diagram the original costs have been kept, as stated, in pfennig and marks. The range of cost from 220 to 40 m. corresponds in American money to from $33 to $9.50 per year with the price of current ranging from 15 to 10c. per kw.-hr.

A 1600-ft. Tower On a Bridge has been designed by an engineer and an architect, of Düsseldorf, Germany, and is proposed by them as the central feature of a future world's fair to be held in that city. Sketches of the design appeared in continental technical journals of recent dates. The base of the structure is a bridge over the Rhine, comprising two 640-ft. spans, which are designed as through spans with stiff parallel-chord arch ribs. Upstream and downstream of the channel pier, about 300 ft. away, two further piers are placed; these two piers and the middle of either arch form the four points of support for four legs or posts, which are the extremities of the spread base of the tower. The main shaft of the tower is quite slender, with inward-curved contour leading to an enlarged diamond-shaped head; below the lower quarter-point the tower spreads out in a sharply-curved sweep to the points of support mentioned. The height proposed is 500 m. (1640 ft.), exceeding that of the Eiffel Tower by two-thirds. The record-breaking height is the chief point of the proposal. As an interesting detail may be noted the fact that the tower, as well as the arch-rib bracing, is to be of the rigid-rectangular type, using no diagonals.

A German Code of Fees

No standard method of charging for architectural and engineering work exists in the United States. In Germany a code of fees has been in use for the past decade, and several earlier codes existed for a quarter century before. We give here a translation of the present German code, adopted in 1901 by six technical associations of architects, civil engineers, mechanical engineers, electrical, heating gas and water engineers.

I. General Clauses

Sec. 1. Principles of Fixing Fees

(1) Fees shall generally be fixed on the basis of the cost of construction, separately for preliminary work and construction. Fees for preliminary work are to be based on estimated cost, fees for construction on actual cost.

(2) Preliminary work includes:

(a) Preliminary sketches with preliminary cost estimates and, if necessary, an explanatory report;

(b) Design, detailed sufficiently for estimating cost;

(c) Cost estimate;

(d) Filing plans, specifications and reports, for securing any required permits or consents.

Construction work includes:

(e) Working or contract drawings;

(f) Supervision. This includes the preparation of call for bids, specifications and contracts, negotiations concerning contracts, determination of time for beginning, continuation and completion of work, supervision of construction, correspondence during construction with authorities and third parties, and audit of bills.

(3) Construction cost from which the fees are to be computed includes all expenditures for construction, excluding the cost of the ground and of supervision as well as architects' and engineers' fees. In case the owner furnishes material and labor, this is to be included in the total cost, on the basis of current local prices, when determining fees.

(4) Payment of the fee entitles the owner to but a single use of the design. For repeat construction, additional fees on the same basis are due.

(5) If an engagement applies to several structures to the same design built at the same time, the fees for preliminary sketches and for supervision are to be computed from the total cost, and those for other work according to the services required. If it covers similar structures to different designs, the fees are to be computed for each separately.

(6) When an engagement covers structures of different kinds, or belonging to separate groups or classes (see classification farther below), the fees may be computed separately for each.

(7) Change of design producing an increase of preliminary work at the direction or with the consent of the owner entitles the architect to additional fees in proportion to the additional services required.

(8) If preliminary sketches only are required, the schedule fee is to be increased by one-half.

(9) When, for a single site, alternative sets of requirements are made, requiring several preliminary designs, each is to be charged for separately. If alternative preliminary sketches to the same requirements are called for, the fees for the first are to be charged in full, but those for the others only in proportion to the additional service involved.

(10) When the design is not preceded by preliminary work, the fee is to be the sum of the separate charges for preliminary sketches and design.

(11) When the owner calls for several complete designs for the same structure, the fees for the first design are to be charged for in full, but those for the others according to the additional labor involved, provided that each design after the first shall be charged for at not less than half the full charge for a single design.

(12) The fee for supervision applies to contract work by individual or general contractors. Work done otherwise than by contract calls for double fee for supervision. The fees chargeable for contract drawings are due even when the design drawings are used directly as contract drawings in whole or in part.

(13) If the engagement is for construction work alone, the fees for working drawings and supervision are to be increased by one-fourth.

(14) Rebuilding is to be charged for at a higher rate, corresponding to the increased amount of services required, but at least one-half higher than the schedule rate.

(15) Discounts or rebates given by material men or contractors are to be paid to the owner.

(16) The owner is entitled to a finished copy of the design without special charge.

Sec. 2. Repayment of Expenses

The schedule of fees does not include expenses for the following, which are to be charged separately:

(17) the cost of securing data necessary for design, such as abstracts, surveys or topographical maps, photographs, soil examinations, borings, hydrological measurements, analyses, statistical data, etc., architectural sketches and drawings required for designs of heating and ventilating, lighting, water supply, sewerage and electrical equipment;

(18) the cost of detail supervision; that is, salaries of superintendents, inspectors, watchmen, etc.; cost of maintaining a separate works office, manifolding drawings and specifications, advertising for bids, and final-estimate surveys, etc. (When a superintendent is employed to handle several structures at the same time, his salary is to be distributed proportionally among the several structures);

(19) in case of buildings, the engineering charges for calculation and design of framing, mechanical plant, etc.; in case of engineering structures, the architectural and other charges for artistic development and ornamentation;

(20) any services rendered in the selection, purchase, sale, use, etc., of real estate or buildings;

(21) expenses for traveling required in connection with the work.

(22) any special drawings needed for check or file, and in case of roads, railways, and canals the final surveys.

Sec. 3. Payment

(23) Progress payments on fees may be demanded up to three-quarters of the value of the services already performed. Three-quarters of the fee for preliminary work is due immediately upon delivery of the sketches and report. Payment of the balance is due within three months after completion of preliminary and construction portions of the engagement, respectively.

Sec. 4. Special Fees

(24) This schedule of fees does not include expert opinions, appraisals, arbitration, stress analyses, artistic rendering, etc.; such work is to be paid for according to required expenditure of labor, standing of architect or engineer, and importance of question involved.

(25) Work to be charged for at a time rate is to be based on the following unit charges:

First hour	20 M. ($5.00)
Each additional hour....	5 M. ($1.25)

(26) Charges for travel should include, besides expenses, also the amount of 30 M. ($7.50) per day or part of a day, but no day should be charged for twice or to more than one employer.

(27) The services of assistants are to be billed in proportion to the nature of their grade or service.

II. Architects' Fees

Sec. 5. Basis of Fees

(28) Fees for architectural services in designing and constructing buildings are to be determined according to:

Cost of building,
Kind of building, and
Ratio of cost of finish to cost of rough work.

(29) The cost of building includes all expenditures. Fees for preliminary work are to be based on the cost estimate, those for construction work upon the actual cost. Whenever the actual cost is not known or has not yet been determined, either the cost estimate or the preliminary estimate is to be used.

(30) The kind of building is determined according to the following classification:

Group I—Sheds, stables, barns, conservatories, warehouses, slaughter houses and stockyards, shops, factories, power plants, and miscellaneous outbuildings.

Group II—Residences, stores, hotels and lodging houses, banks, schools, barracks, prisons, hospitals and other institutions, baths, markets, business buildings, office buildings, administration buildings, and all other buildings not specially named in Groups I and III.

Group III—Churches, cemetery buildings, memorial halls, colleges, academies, libraries, museums, theaters, concert halls, exchanges, legislative buildings.

Group IV—Monuments, fountains, grottoes, arbors, garden furnishings, interior fittings, festive or mourning decorations, altars, chancels, and similar equipment items.

Group V—Furniture and art objects, lighting fixtures, apparatus, etc.

(31) The cost of finish includes that part of the total cost used for finishing and decorating the structure, and this is to be given separately in all cost estimates and final cost summaries. The separation is to be made on the following basis:

Rough Work	Finish Work
Excavation	.....
Masonry work	Facing
Stone work; furnishing and placing material with simple dressing. (ordinarily to be taken as two-thirds of total cost.)	Additional cost of molding and ornamental work (ordinarily taken as one-third of total cost.)
Asphalting and waterproofing.	.....
Carpenter work; all rough framing, studding, and trussing.	Additions for ornamentation and trimming of exposed wood parts; floors; wooden stairs.
Ironwork	Ornamental ironwork.
Roofing and tinning	Metal ornaments.
.....	Plaster and stucco work.
.....	Stone carving and sculpture from models.
.....	Interior tiling, flooring.
.....	Joinery, glazing and hardware work.
.....	Painting, decorating, paperhanging.
.....	Heating and ventilating equipment; stove setting.
.....	Water, gas, and plumbing.
.....	Electric and mechanical equipment.
Paving, walks and gardens.	.....

Sec. 6. Schedule of Fees

(32) The total fees are to be computed according to the adjoining Table I, in percentages of the total cost, the percentages increasing with the number of the group and with increasing finish-ratio, but decreasing with increased total cost.

(33) The base charges given in the table for Groups I to IV correspond to the minimum finish-ratios given at the head of the respective columns. These base charges are to be increased for each additional 1% of finish-ratio by the amount given in Col. 6.

(34) When the finish-ratio is not known it is to be taken at the minimum given in the table; after the design is completed, the architect may, however, determine the actual ratio by a cost estimate.

(35) The fees are to be divided as follows:

For preliminary work:

	Percentages of total schedule fee		
(a) Preliminary sketches	10%	30%	40%
(b) Design	20%		
(c) Cost estimate	7%	10%	
(d) File plans	3%		

For construction work:

(e) Working plans	40%	60%
(f) Supervisor	20%	

III. Engineering Fees

Sec. 7. Methods of Computing Fees

(36) For computing fees, engineering works other than buildings are to be grouped in one of three classes, according as the charge is to be computed by

(A) percentage of cost,
(B) length of line,
(C) area of territory.

Group A is divided into four classes, 1, 2, 3 and 4.

(37) For work in Groups B and C, upper and lower limits of fees are given, for simple and difficult conditions. The fees is any particular case are to be agreed upon between these limits with the owner.

(38) The question whether simple or difficult conditions prevail is to be decided according to topography, other conditions of the work, and technical questions involved.

(39) Work costing less than 5000 M. ($1250) may be charged for on a time basis.

(40) The division of engineering fees is to be as follows:

Kind of service	Per cent. of total fee
Preliminary plan and estimate	25
Design and complete estimate	30
File plans	5
Contract and construction plans	10
Supervision of construction	30

TABLE I—SCHEDULE OF ARCHITECTURAL FEES, IN PER CENT. OF TOTAL COST

1	2	3	4	5	6	7
		Base charge for Group			Add in Groups	
	I	II	III	IV	I-IV for	Charge for Group
Cost,		For finish-ratios			each 1%	
Mark*	20%	30%	40%	50%	additional	V
1,000	6.00	9.00	12.00	15.00	0.135	21.00
2,000	5.60	8.40	11.20	14.00	0.125	19.60
3,000	5.30	8.00	10.60	13.30	0.120	18.60
4,000	5.10	7.70	10.20	12.80	0.115	17.90
5,000	4.90	7.40	9.80	12.30	0.110	17.20
6,000	4.80	7.20	9.60	12.00	0.108	16.80
7,000	4.70	7.00	9.40	11.70	0.106	16.40
8,000	4.60	6.90	9.20	11.50	0.104	16.10
9,000	4.55	6.85	9.10	11.40	0.103	15.95
10,000	4.50	6.80	9.00	11.30	0.102	15.80
15,000	4.30	6.50	8.60	10.80	0.097	15.10
20,000	4.10	6.20	8.20	10.30	0.093	14.50
25,000	4.00	6.00	8.00	10.00	0.090	14.00
30,000	3.90	5.85	7.80	9.70	0.088	13.60
35,000	3.80	5.70	7.60	9.50	0.086	13.30
40,000	3.70	5.55	7.40	9.30	0.084	13.00
50,000	3.60	5.40	7.20	9.00	0.081	12.60
60,000	3.50	5.25	7.00	8.70	0.079	12.20
70,000	3.40	5.10	6.80	8.50	0.077	11.90
80,000	3.35	5.05	6.70	8.40	0.076	11.75
90,000	3.30	5.00	6.60	8.30	0.075	11.60
100,000	3.25	4.95	6.50	8.20	0.074	11.45
150,000	3.10	4.70	6.20	7.80	0.070	10.90
200,000	3.00	4.50	6.00	7.50	0.067	10.50
250,000	2.90	4.30	5.80	7.20	0.065	10.10
300,000	2.80	4.20	5.60	7.00	0.063	9.80
350,000	2.75	4.10	5.50	6.90	0.062	9.65
400,000	2.70	4.00	5.40	6.80	0.061	9.50
500,000	2.65	3.90	5.30	6.60	0.059	9.25
600,000	2.60	3.80	5.20	6.40	0.058	9.00
700,000	2.55	3.75	5.10	6.30	0.057	8.85
800,000	2.50	3.70	5.00	6.20	0.056	8.70
900,000	2.45	3.65	4.90	6.10	0.055	8.55
1,000,000	2.40	3.60	4.80	6.00	0.054	8.40
1,250,000	2.30	3.45	4.60	5.80	0.052	8.10
1,500,000	2.20	3.30	4.45	5.60	0.050	7.80
2,000,000	2.10	3.20	4.30	5.40	0.049	7.50
2,500,000	2.05	3.10	4.15	5.20	0.047	7.25
3,000,000	2.00	3.00	4.00	5.00	0.045	7.00
4,000,000	1.95	2.95	3.90	4.90	0.044	6.85
5,000,000	1.90	2.90	3.80	4.80	0.043	6.70
6,000,000	1.85	2.85	3.70	4.70	0.042	6.55
7,000,000	1.80	2.80	3.65	4.60	0.041	6.40
10,000,000	1.75	2.70	3.55	4.50	0.040	6.30

*1000 M = abt. $240.

NOTE.—When the cost falls between two successive figures of Col. 1, the lower figure may be taken if the fee is thereby increased.

SEC. 8. PERCENTAGE FEES (GROUP A)

(41) This class includes all kinds of engineering work not belonging to Groups B and C, as follows:

CLASS 1: Trestles, simple bridges up to 33-ft. span, simple culverts, earthwork, electric transmission and distribution lines, bank protection, rock excavation, canal linings, channels, simple ditches, simple harbors, slope paving, plain pipe lines, road location, street improvements, retaining walls on ordinary foundations, simple fixed dams.

CLASS 2: Simple railroad sidings and stations with more than two yard tracks for each main track (smaller stations are to be figured by the mile under class B), underground reservoirs and tanks, fixed bridges 33- to 95-ft. span, sewerage, dikes, siphons, difficult culverts, factory buildings and equipment, small ferries, river regulation and canalization, gas-works plant, foundations (except compressed air and freezing method), difficult harbors, heating plants, shipyards, electric plants, water supply, simple framing for buildings, ventilating plants, drainage plants, simple navigation locks, warehouses comprising mechanical equipment, difficult road construction, small dams, simple tunnels, seawalls with difficult foundations, power development, simple movable dams, difficult fixed dams.

CLASS 3: Complicated railroad layouts and stations, reservoirs and tanks for gases and liquids above ground, high aqueducts, movable bridges, complicated building framing, large bridges, skew arch bridges, railway ferries, freezing-method foundations, compressed-air foundations, inclined planes, canal lifts, difficult locks, wharves, dry docks and floating dry docks, large dams, high viaducts, difficult tunnels, difficult movable dams.

CLASS 4: Mechanical plants and machinery of all kinds.

(42) The fees for work in these four classes are to be computed as percentages of the total cost according to the accompanying Table II.

TABLE II.—SCHEDULE OF ENGINEERING FEES IN PER CENT. OF TOTAL COST.

Cost Mark*	Class 1	2	3	4
5,000	8.0	12.0	16.0	16.0
10,000	6.7	10.5	13.4	13.4
20,000	5.8	8.7	11.7	11.7
30,000	5.3	7.9	10.6	10.6
40,000	4.9	7.4	9.9	9.9
50,000	4.7	7.0	9.5	9.3
60,000	4.5	6.8	9.2	8.8
70,000	4.3	6.5	9.0	8.4
80,000	4.1	6.3	8.8	8.0
90,000	4.0	6.2	8.6	7.7
100,000	3.9	6.0	8.5	7.3
150,000	3.5	5.6	7.9	6.2
200,000	3.4	5.2	7.5	5.5
300,000	3.2	4.8	6.8	4.9
400,000	3.2	4.6	6.4	4.6
500,000	3.2	4.4	6.0	4.4
600,000	3.2	4.3	5.6	4.3
700,000	3.1	4.2	5.3	4.2
800,000	3.1	4.1	5.2	4.1
900,000	3.0	4.1	5.1	4.1
1,000,000	3.0	4.0	5.0	4.0
2,000,000	2.7	3.6	4.5	3.6
3,000,000	2.4	3.2	4.0	3.2

*1000 M = abt. $240.

NOTE.—When the cost falls between two successive figures of Col. 1, the lower figure may be taken if the fee is thereby increased.

SEC. 9. FEES BASED ON LENGTH OF LINE (GROUP B)

(43) The engineer's work in this group is the following:

General Preliminary Work [Sec. 1, (2a)]—Going over the line, sketching line and profile, preparing explanatory report and estimate.

Detailed Study [Sec. 1, (2b), (2c), (2d)]—Conduct of all preliminary work, on basis of existing maps which, if necessary, are to be supplemented; preparation of profile and cross-sections where necessary; preparation of standard designs for structures and details occurring repeatedly; location of structures; explanatory report; cost estimate. All structures which are not to be built according to standard designs may be separately charged for according to their total cost.

Construction Work [Sec. 1, (2e), (2f)].

(44) EMBANKMENTS, ROADS—The fees per mile length of line are to be: for ordinary conditions, 1280 M. ($320); for difficult conditions, 3850 M. ($960).

(45) RAILWAYS, STREET RAILWAYS, WATER CONDUITS, CANALS—The fees per mile length of line are to be: for ordinary conditions, 1925 M. ($475); for difficult conditions, 5800 M. ($1400).

SEC. 10. FEES BASED ON AREA COVERED (GROUP C)

(46) The engineer's work under this group covers the following:

General Preliminary Work [Sec. 1, (2a)]—Going over area, preparing preliminary sketch by use of existing maps and profiles, making general layout of proposed work, preparing explanatory report and cost estimate.

Detailed Study [Sec. 1, (2b), (2c), (2d)]—Procuring all data for design, using existing maps, preparation of standard designs for repetition structures and details, fixing the general dimensions of special structures, preparing explanatory

Construction Work — [Sec. 1, (2e), (2f)].

Construction Work—This includes the preparation of working plans, securing bids, letting contracts and supervising the construction, etc. [Sec. 1, (2e), (2f)].

(47) MUNICIPAL PLANNING—The work required under this head corresponds to preliminary studies and design in the table of subdivision of fees given previously; according to circumstances, the total fee may be divided between the two items in the ratio 25 to 30 as there given, or 1 to 1. The fees per acre of area are to be: for ordinary conditions, 81 M. ($20); for difficult conditions, 243 M. ($58).

(48) AGRICULTURAL IRRIGATION AND DRAINAGE PLANS—The fees per acre are to be: for ordinary conditions, 122 M. ($29); for difficult conditions, 365 M. ($87).

Two Units of Car Capacity—The long-standing custom of stating the capacity of passenger cars in terms of the number of persons who can be transported at one time does not appear to fit all cases.

We read in the "Zeitschrift des Oesterreichischen Ingenieur und Architekten Vereines," of Nov. 15, 1912, an item concerning the new monorail line in the tunnel between the Capitol and the Senate office building at Washington, the following statement:

The rolling-stock consists of a single car, which is designed to carry 12 senators or 36 employees.

Land Reclamation by Drainage

The Western Society of Engineers, on Nov. 18, had before it a paper on "The National Aspect of the Reclamation of Swamp and Overflowed Lands," by Edmund T. Perkins. The U. S. Department of Agriculture estimates 77,000,000 acres as the total area of such lands available for reclamation; their present value averages about $8 per acre, and the cost of draining and fitting them for cultivation averages $15 per acre. The value of such areas as have been reclaimed ranges from $60 to $100 per acre, while in some favorable locations $400 per acre has been reached. The work of reclamation on a large scale should not be limited by the arbitrary lines of state boundaries, but some way must be found of treating as one project any one swamp area which extends into two or more states. This, however, presents a difficult problem.

In 1850 the federal government granted to the several states all swamp and overflowed lands within their borders in order that the proceeds of their sale should be used in reclaiming them; but so far Florida is the only state that is complying with the law, and practically all swamp lands in other states have passed into private ownership. In drainage experiments one piece of land cannot be improved without improving others. This has led most of the states having swamp lands to pass laws permitting the organizing of drainage districts by a majority of the land owners therein, with compulsory payment of a share of the cost of improvement by all owners within the district.

In the discussion, Lyman E. Cooley stated that in his opinion drainage of wet lands is more important than irrigation of arid lands. The former are at lower altitudes, nearer the centers of population, along the lines of water-courses and railways, and have a greater variety of production. The federal government has no proprietary interest in these lands, as it has in the arid lands, and cannot undertake their drainage and improvement in the same way as it has undertaken the irrigation of its arid lands. But under a provision of the Constitution, two or more states can cooperate, with the consent of Congress. This authority has never yet been invoked, but Mr. Cooley considered that it offers a solution of the problem of carrying out an improvement project which affects adjacent states.

The president, Mr. Armstrong, suggested that land reclamation by drainage is a promising but neglected field for investment. He instanced a case where tracts of a few thousand acres valued at $15 to $20 per acre were improved at a cost of $30 per acre, the funds being provided by bonds running for 15 to 20 years. These lands now produce 12% on a valuation of $150 per acre.

The Effect of Hydrogen Sulphide on the Concrete of Sewage Disposal Plants*

By William M. Barr† and R. E. Buchanan†

It is well known to those who are familiar with the operation of the septic tank, that, in the chambers of such tanks, which operate in the absence of light and air, the bacteria produce, in the decomposition of the organic matter of the sewage, quantities of reducing gases. Among these decomposition products is observed more or less hydrogen sulphide gas, resulting in most cases from the decomposition of organic sulphur compounds existing in the sewage. In most tanks of this character the amount of hydrogen sulphide thus liberated is not sufficiently large to cause complaint from excessive odors or to account for conditions observed in certain tanks by the writers.

Attention was first called to the disintegration of cement mortar in concrete resulting from sewer gases, by Frank H. Olmstead, City Engineer of Los Angeles, Calif., and his deputy, Homer Hamlin, in 1900.‡ The case observed by them occurred in the outfall sewer for Los Angeles, built in 1895. This resulted from the holding back of the sewage in inverted siphons in this outfall sewer, forming, in principle, a septic tank. Beyond this point the neat cement mortar was badly disintegrated and it became necessary to consider the reconstruction of the walls and roof of this portion of the sewer. It was observed that this disintegration resulted from the formation of sulphuric acid upon the walls and roof, which attacked the cement, giving calcium sulphate or gypsum as the final product. It was also observed that the amount of sulphuric acid formed appeared to be too large to have been produced by the organic sulphur compounds in the sewage proper. Mr. Hamlin suggests that the only possible sources of this excessive amount of sulphur were the oil wells and the sulphur which is always present in small quantities in the normal sewage. The reports do not indicate that the source of these sulphur products was located.

Two other cases have come to our attention where such a condition appeared to exist, but owing to distance an investigation of these cases was not made.

As early as November, 1908, one of us visited the sewage-disposal plant of the Inebriate Hospital at Knoxville, Iowa, and observed the following conditions: The concrete composing the roof and portions of the walls above the high-water line in the dosing chamber was rapidly disintegrating. The undersurface of the roof was found to be decomposed to a depth of two or more centimeters. Quantities of free sulphur were deposited on the walls, and the calcium compounds of the cement were found to have been converted near the surface into crystals of gypsum. Large quantities of hydrogen sulphide were given off when the dosing chamber discharged, causing complaint of foul odors by neighbors and residents at the hospital.

Not long after this date a similar condition was observed in the septic tank operated by the city of Grinnell, Iowa.

In both these cases, various measures have been tried to prevent the formation of excessive odors and decomposition of the concrete. A water-softening plant was put in at the Knoxville institution, thinking this might improve conditions, but, except for making the water more desirable for domestic purposes, nothing was achieved. Frequent cleaning of the tank, and disinfecting at the time of cleaning, did not materially help matters.

During the progress of this investigation our attention was called to the septic tank at the State Hospital at Mt. Pleasant, Iowa, and before visiting the place, an analysis of the water-supply used by the hospital caused us to predict the conditions existing there. A visit confirmed the prediction, in that the septic tank there was found to be in about the same condition as the two first examined.

The object of this investigation was to determine the cause of the conditions already stated, and to determine whether bacteria were in any measure responsible for the changes, or whether they were purely of a chemical nature.

The various observations made by us, together with analysis of the water-supplies and the sewage, seemed to point to some definite relationship existing between the compounds of sulphur in the water-supply and the formation of excessive hydrogen sulphide, with consequent formation of sulphuric acid on the walls of the dosing chamber and disintegration of the concrete.

This was used for a working hypothesis for the following reasons:

(1) The water supplies in the cases observed were found to have an unusually high content of sulphates.

(2) The odor of hydrogen sulphide was, in all cases, very pronounced about the dosing chamber.

(3) Free sulphur was found floating on the surface of sewage which had been standing for some time, and quantities of free sulphur were deposited on the walls in various parts of the septic tank.

(4) An abundance of sulphur bacteria was evident upon microscopic examination.

(5) The disintegrating concrete showed much greater amounts of sulphate than the unaffected concrete, and as already stated, showed crystals of gypsum on microscopic examination.

Evolution of Hydrogen Sulphide from Organic Compounds

A large proportion of proteins contain a considerable percentage of sulphur. When such compounds are decomposed in the absence of oxygen, the sulphur makes its appearance for the most part in combination with hydrogen as hydrogen sulphide. Inasmuch as proteins and the products of hydrolytic cleavage are generally to be found in sewage, it is to be expected that a certain amount of hydrogen sulphide will be developed in such sewage as it passes through an anaerobic septic tank. The quantity so produced is not large and ordinarily little of it escapes into the air. Even in open septic tanks the heavy membrane or scum which usually forms contains many oxidizing bacteria, which may effectually prevent the escape of hydrogen sulphide. In this specific instance the amount of hydrogen sulphide evolved cannot be entirely accounted for by the decomposition of such protein substances, for analyses of the raw sewage show it to be no higher in albuminoid ammonia, that is to say, proteins and their decomposition products, than sewage from other disposal plants in which there is much less evolution of this gas.

Reduction of Sulphates to Sulphides

Chemical analyses of the raw sewage and effluents were made to determine the amount of sulphates in solution, and the total sulphates in the raw sewage (Tables I and II). These results indicate, first, that the organic matter in normal sewage does not contain enough sulphur to produce the quantities of hydrogen sulphide observed; second, that where the sulphates in the original water-supply are

TABLE I. CHEMICAL ANALYSES OF RAW SEWAGE

Parts per Million.

	Nitrogen as							
	Free Ammonia	Albuminoid Ammonia	Nitrites	Nitrates	Chlorine	Oxygen Consumed	Solids on Evaporation	Solids on Ignition
Hospital for Inebriates	21.00	6.50	none	none	35.0	53.31	3040	2484
	32.60	4.60	trace	trace	.....	114.7	3902	2624
Grinnell, City Plant	6.50	6.00	high	none	54.0	17.18	950	776
Grinnell, City Plant	11.50	6.00	.....	..	122.0	10.74	1114	894
*Knoxville, City Plant	25.00	6.00	trace	none	33.0	63.60	800	538
*Ames, City Plant	18.20	8.20	...	...	.....	....	552	251

*Excessive hydrogen sulphide could not be observed at these plants. All other plants examined, where the water supply contained a smaller sulphide content than that shown for the city of Knoxville in the next table, showed no excessive odor of hydrogen sulphide.

*Bulletin, Iowa State College of Agriculture and Mechanic Arts, V. 10, No. 4, Jan., 1912.

†Iowa State College, Ames, Iowa.

‡Engineering News, p. 317.

high, there is a marked reduction in the amount of mineral sulphates found in the effluent, showing that a portion of these mineral sulphates must have been reduced and removed from solution.

In the three cases where excessive hydrogen sulphite was observed these relations are very marked. Several other septic tanks were observed where the sulphates (SO_4) in the water-supply ranged from 16 parts per million to 143 parts per million, as at the Knoxville city plant, and in all cases very little hydrogen sulphide could be detected at the sewage-disposal plant. The Knoxville city plant shows the highest sulphates in the raw sewage of any plant observed where excessive odors of hydrogen sulphide did not appear and it is doubtful whether this amount of sulphates might not cause trouble in some cases.

Table II shows the amount of sulphur in the sewage calculated as SO_4 and the amount in the effluents, showing how it has been removed by reduction to hydrogen sulphide:

TABLE II. REDUCTION OF SULPHATES TO SULPHIDES

Inebriate Hospital		Total Sulphur SO	Soluble Sulphur SO_4
		(Parts per million)	
Knoxville, Ia.	Water supply	1664	1664
	Softened water	1566	1566
	Raw sewage	1552	1533
	Tank effluent	...	965
Grinnell, Ia.	Water supply	476	476
	Raw sewage	452	427
	Tank effluent	381	352
Mt. Pleasant, Ia.	Water supply	900	900
	Raw sewage	871	850
	Tank effluent	716	690
Knoxville, Ia.	Water supply	143	143
	Raw sewage	163	147
	Tank effluent	...	145

The investigations of various European workers have demonstrated that certain anærobic bacteria in the presence of organic substances reduce sulphates to sulphides. Each of these investigators isolated specific organisms, which, when inoculated into sterile solutions containing sulphates and a little organic matter, brought about a very considerable evolution of H_2S. It was, therefore, thought possible that the large amount of this gas given off in the septic tank and the dosing chamber might be due in part at least to a reduction of the sulphates of the water supply. A chemical analysis of this water showed it to be exceptionally high in sulphates. Tests were accordingly made to determine whether or not such sulphates under the septic conditions of this plant would be transformed into sulphides.

[These tests consisted in inoculating sterile media, under anærobic conditions, with specimens of the sewage in question and observing the appearance of iron sulphide deposited from some iron sulphate added as indicator.—ED. ENG. NEWS.]

It was evident that bacteria having the power to reduce sulphates to sulphides were present in numbers in the sewage in question. The quantity of sulphate daily entering the plant justifies the conclusion that much of the H_2S developed in the tank is formed by the deoxidation of such sulphates. The relative importance of protein decomposition and sulphate reduction in the production of H_2S cannot at present be determined.

[Further investigations showed that it was possible to isolate the bacteria which can reduce the sulphates to sulphides. The bulletin further calls attention to similar bacteria which previous investigations had succeeded in isolating. —ED. ENG. NEWS.]

THE OXIDATION OF SULPHIDES TO SULPHATES

Examination of the dosing chambers of the tanks observed, showed that the moisture on the walls was strongly acid with sulphuric acid. A considerable portion of this acid was doubtless produced by atmospheric oxidation of the hydrogen sulphide, which of itself might account for the formation of the sulphuric acid and the sulphates found. The bacterial study, however, shows another agent which aids materially in the oxidation of the hydrogen sulphide.

The work of Winogradsky, Engelman, Miyoshi, and others, has shown that certain groups of bacteria under ærobic conditions may utilize hydrogen sulphide by direct or indirect oxidation as a source of energy. The first evidence of such oxidation is frequently the accumulation within the bacterial cell of granules of free sulphur. These may be recognized microscopically by their relatively high refractive index, by their solubility in carbon disulphide and by the characteristic crystals which form when such solutions are allowed to dry upon a glass slide. These organisms are found later to further oxidize this free sulphur, the final product being sulphuric acid. The organic food requirements of these bacteria seem to be very small indeed; many apparently utilize the carbon dioxide of the atmosphere and very simple compounds of nitrogen.

In an examination of the septic tank in question one of these oxidizing sulphur organisms (*Beggiatoa*) was found growing abundantly in some places on the surface of the scum. Disintegrating concrete, moreover, was covered by a luxuriant growth of molds and bacteria. A comparison of the chemical analysis of undisintegrated concrete (Table IV), and that which had undergone partial disintegration shows a notable increase in the amount of sulphate present in the latter. It should be noted further that the concrete below the water line of the septic tank and dosing chamber had disintegrated little or none at all. It seemed evident, therefore, that hydrogen sulphide alone could not be the immediate cause of such disintegration, for it is constantly present in the sewage in contact with these walls. Inasmuch as bacteria, however, seemed to thrive in the moisture generally present on the under side of the roof and on the walls, it seems probable that much of the hydrogen sulphide arising from the sewage is absorbed and then converted into sulphuric acid through the agency of bacteria.

TABLE III. ANALYSIS OF DISINTEGRATED CEMENT WALL IN SEPTIC TANK AT GRINNELL, IOWA

(Showing variation in sulphur content of different parts of concrete.
The outer layer consisted largely of a deposit of free sulphur).

	Free Sulphur	Sulphates (SO_4)
First or outer layer, about one cm. thick	19.7%	1.2%
Second layer, immediately beneath first	7.2%	21.0%
Third layer, about five cm. below surface	0.27%	6.75%

Flasks containing various sulphides were inoculated with material from the disintegrated concrete and examined from time to time. In some of these flasks Beggiatoa filaments developed, showing their characteristic sulphur granules within the cells. However, active oxidation of the sulphides to sulphates occurred in the other flasks in the absence of Beggiatoa, apparently through the agency of other bacteria which swarmed in such cultures.

The data at hand are sufficient to convince us that bacteria may be responsible, in part at least, for the oxidation of sulphides to sulphates under the conditions as they exist in the sewage-disposal plants here discussed.

DECOMPOSITION OF CONCRETE BY SULPHURIC ACID

As rapidly as sulphuric acid is produced by bacteria working in and on the concrete or by atmospheric oxidation, it reacts with the calcium compounds of the cement, forming calcium sulphate or gypsum.

This takes up water of crystalization and swells considerably, the result being a cracking and pulverizing action and a consequent disintegration.

BACTERIAL DISINTEGRATION OF CONCRETE

Careful search has failed to reveal any account of *bacterial* disintegration of concrete through the action of sulphides or sulphates. R. Grieg Smith investigated the disintegration of concrete in the open canals that convey the city water-supply of Sydney, New South Wales. He was led to study the action of nitrifying bacteria on concrete through the work of Stutzer and Hartleb, who suggest that such forms might assist in the disintegration of the cement of water reservoirs. He concludes, however, that "there is considerable room for doubt regarding the action of micro-organisms on cement. There is more reason to believe that the action is purely chemical." His conclusion would seem to agree with those of Tannatt and Burke, who found disintegration of concrete tile to take place

when in contact with soil rich in sulphates. That even in alkaline regions bacteria may possibly have something to do with concrete disintegration is evidenced from the work here recorded and the statement of Schreiner, Oswald and Failyer to the effect that hydrogen sulphide is produced in the drainage waters from gypsum alkali lands and from iron pyrites.

Summary

1. In three of the sewage-disposal plants observed, viz., Grinnell, State Inebriate Hospital and State Hospital at Mt. Pleasant, large quantities of hydrogen sulphide are evolved. This sulphide is produced in two ways: (a) By the bacterial decomposition of sulphur-containing proteins and related compounds and (b) the reduction of sulphates which are contained in unusual amounts in the water-supplies used. Of the two the second seems to be the more important.

2. The organism chiefly responsible for the reduction of sulphates and evolution of the sulphides is a spiral bacterium closely related to, if not identical with, *Spirillum desulfuricans*.

3. The hydrogen sulphide which escapes as gas from the sewage, particularly in the dosing chamber, is partially dissolved in the moisture on the under side of the roof and concrete walls. Here it is oxidized to sulphuric acid partly by atmospheric oxidation and partly by bacterial action. The sulphuric acid acts upon the calcium compounds in the concrete forming calcium sulphate, and breaking down the concrete. An excess of free sulphur is often deposited which the oxidizing agencies have not converted into sulphate.

4. The exact species of the organisms responsible for the conversion of hydrogen sulphide into sulphuric acid have not been determined. That bacteria, however, in mixed cultures may bring about this change has been demonstrated. Beggiatoa and a Bacillus have been isolated and probably are the most important organisms in bringing about this change.

Four Concrete Viaducts at Fort Worth, Texas

Within the city limits of Fort Worth, Tex., the county authorities are now constructing four large concrete viaducts, one of which, illustrated in the accompanying architect's perspective, is of considerable size. The bridge shown here is known as the Main St. Viaduct and crosses the Trinity River.

The length of this structure is 1752 ft. and comprises one arch span of 225 ft. (over the stream), two 175-ft. arch spans, one 150-ft. arch span, three 62½-ft. girder spans, seven 50-ft. girder spans, one 25-ft. girder span and a stretch of retaining-wall inclosing an earth fill. All of the above spans are measured from center to center of piers. The roadway is 54 ft. between curbs and there are two 8-ft. sidewalks. About the middle of the bridge is a reinforced-concrete stairway leading to the street.

The arch spans are all of the three-hinged ribbed type having structural-steel reinforcement. This structural-steel reinforcement is designed to carry the weight of the forms for the arch ribs, together with the weight of the plastic concrete for same, so that no falsework supported from the ground will be necessary. The only falsework required will be that for the girder spans. The ribs are braced together at the foot of each post by means of structural-steel frames encased in concrete. The hinges consist of steel castings having hemispherical bearings, the castings being attached to the structural reinforcement. The arches are so designed that in no case will the erection stresses exceed those which will occur under the working conditions.

The viaduct will carry two electric interurban tracks in the center of the roadway, which will be paved either with creosoted wood block or vitrified brick, to be decided later.

Foundations on one end extend to bedrock, while at the other spread footings, resting on a sand-and-gravel foundation, will be used for the main piers. The retaining-walls and piers under the small girder spans rest on a dense black clay.

The other three viaducts are of similar design to the one just described, but are considerably smaller. The West Seventh St. Viaduct has a total length of 1041 ft. The Samuels Ave. and East Fourth St. Viaducts are each 438 ft. long.

The contract for the Main St. Viaduct has been let to the Hannan-Hickey Bros. Construction Co., of St. Louis, whose bid was $373,952. The Tarrant Construction Co., of Fort Worth, has secured the contract for the West Seventh St. Viaduct, its bid being $106,772. Plans for the other two viaducts are not yet complete, but it is probable that the total cost of the four viaducts will be in the neighborhood of $650,000.

All of the structures were designed by Brenneke & Fay, of St. Louis, Mo., under the direct supervision of S. W. Bowen.

THE MAIN ST. VIADUCT, FORT WORTH, TEXAS
(Designed by Brenneke & Fay, St. Louis, Mo.)

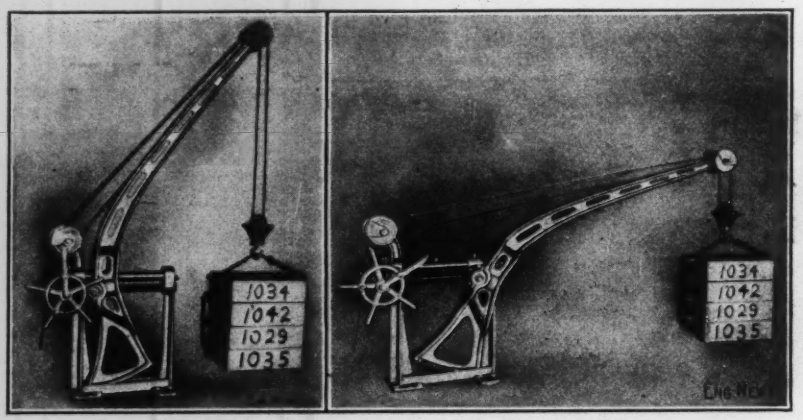
Diamond-drill Borings are being made at Chicago for two intake tunnels under Lake Michigan, as an addition to the water-supply system. One of these tunnels is on the north side, at Bryn Mawr, and the other is at 35th St., to serve the stock-yards district. It is desired to have the tunnels in solid rock, and to avoid the seamy and irregular strata, which have caused so much trouble in the earlier tunnels. For this reason the drill holes are made deep enough to indicate that there will be solid rock above and below the tunnel grade.

The drilling extends to a distance of three miles from shore in each case, the maximum depth of water being 38 ft. The deepest hole is 138 ft. deep. Many boulders are encountered, and large pockets in the rock; also some ledges of rock about 2 ft. thick, which at first appear to be solid rock, but are found to be underlaid by water-bearing sand. The drilling rig is mounted on a platform, 14x14 ft., supported by 65-ft. piles driven until their tops are about 10 ft. above the water. The tripod is of 30-ft. cedar poles, so as to give ample headway for handling 24-ft. lengths of drill rods. The drill is of the Standard Diamond Drill Co.'s make; it is unusually light, weighing only about 350 lb., so that it can be handled easily and taken to and from the work each day on a scow. The work is in charge of F. A. Smith, Assistant Engineer in the Bureau of Engineering, of the city of Chicago.

A Quadrant Crane for Motor Trucks*

The principle of a quadrant davit for lowering life-boats from the decks of vessels (see ENGINEERING NEWS, May 23, 1912) is embodied in the design of crane shown in the accompanying figures. The boom here serves as a strut between the crane base and the hoisting cable, so that the thrust on the screw for advancing or retreating the boom is greatly lightened and in some positions quite balanced. By control of the curve given to the rocker bottom of the boom by which the pivoting point is moved forward, together with design of hoist tackle, it is possible to control the position of the load without hauling on the hoist cable. In the design shown the load remains at practically the same elevation as it moves forward or back.

The figures on the weights suspended from the boom show a test load used on a 1-ton crane. In this test it was possible for one man with the crank attached to the pilot wheel to raise the boom from the lowest to the highest position without over-exertion. This screw is actuated by the crank and pilot wheel through gun-metal beveled gears having a ratio of 1½ to 1; with a 1-ton load a man can move the boom between its limiting positions in 30 sec.



A 1-TON QUADRANT CRANE FOR MOTOR TRUCKS

The general dimensions of the 1-ton crane shown are as follows:

Maximum outreach, 7 ft. from front of frame.
Minimum outreach, 2 ft. from front of frame.
Maximum height, 9 ft. 10 in.
Minimum height, 6 ft. 2 in.
Weight, 1150 lb.

The frame, boom and nut are open-hearth-steel castings. The tie-rod, between the two arms of the base, on which the nut slides is of cold-rolled steel covered with brass tubing. The screw is of 30% nickel steel to avoid corrosion in service; it is mounted on self-aligning radial and thrust ball-bearings. The nut is lined with phosphor bronze.

The crane shown is designed for use on trucks and up to the present has been made without a turntable. There is no reason, however, why it should not be mounted to swing horizontally through any desired number of degrees. It is intended that the hoisting cable be wound by an electric hoist on a storage-battery truck or by a hoist driven directly from the transmission gear of a gasoline truck.

*From information furnished by the La Salle Machine & Tool Co., La Salle, Ill.

Investigation of a Compound for Producing Dustless Concrete Floors

BY ALBERT C. AREND*

Ever since the wide utility and comparative economy of reinforced-concrete buildings became to be generally appreciated, there has been such a steadily increasing percentage of this type of construction that today their number must be legion, and the larger portion of these buildings have finished concrete floor surfaces. There are, in addition, thousands of buildings of mill and other type constructions which have a floor or a portion of a floor or a shipping platform with a concrete surface, which floors are one of the most important features of a business building.

It has been the common practice to finish these surfaces smooth and similar to sidewalks—some with expansion joints, some continuously, and others marked off into squares just for the sake of appearance, with squares usually varying from 4 ft. to 6 ft. in size. The concrete mixture specified has varied all the way from 1:1 to 1:3 (granite chips sometimes being substituted for a portion of the sand), and the workmanship has varied in about as wide a range as to experience and ability. These floors are usually specified and supervised by architects, but even when under the charge of engineers, there has been no clearly defined line of action or standard of perfection adhered to. At best it has ordinarily resolved itself into obtaining the best results which the contractor's workmen could produce. As a consequence there are many differing degrees of perfection in the surface condition of different sections of the same floor, ranging from the hard smooth surface which has been tooled to a finish at just the proper time, to the trowel-marked porous surface which has been left too soon because "quitting time" came or it got too dark, etc.

In some instances the finishing work of these floors has been uniformly well done, or the traffic is very light, or the dusting and crumbling which may be continuously taking place is not particularly objectionable; but there are more instances where the owners have come to feel that they have "sick" floors, and these owners are usually "easy marks" for a versatile salesman with a "cure." These floors may have worn away and become a nuisance on account of their unevenness or an eyesore from appearance or a menace to their structural strength, or the continuous dusting may be a very serious objection for many reasons. Then the owner is ready to pay any price for the "sure cure" which seems all right and can be made up into pretty little samples which his best pocket knife or letter opener can hardly scratch, and he orders a liberal amount of the "cure" without any further investigation as to its performance in real life.

There have been several instances where a price of 30c. per lb. was paid for one of these remedies, and when it was used as specified it required 10 oz. of the remedy per square foot of the surface finished, which made the total resurfacing costs about 22c. per sq.ft.

As a result of the purchase and use of one of these remedies without any improved results, an investigation and series of tests was determined upon by the writer, first to determine if the remedy had been used in the most effective manner, and second, to decide for or against its use for an important new building then under construction.

The material tested has been described by the manufacturers as an inert mineral powder which, if used as per instructions, would impart to concrete in general, and floor surfaces in particular, an iron-like wearing surface which would be dustless and waterproof. Upon close inspection it seemed to consist essentially of finely ground metallic iron in combination with ammonium chloride, the latter element being probably intended to accelerate the oxidation of the iron and also assisting materially with the bonding characteristics developed.

The instructions for using this iron ad-

*Consulting engineer, Brandeis Bldg., Omaha, Neb.

mixture were essentially to first clean the top surface of the floor slab thoroughly and wet it, and then to brush same with a slush bonding coat—using about 5 lb. of the iron and an equal weight of portland cement per 100 sq.ft. of surface, mixing this first dry and then with sufficient water. Then the surface coat, to consist of a ¾-in., or thicker course, was to be mixed in the proportions of one of portland cement, plus 15% to 20% by weight of iron, to two of sand, by volume. The cement and iron were to be mixed dry and then the sand and water added, and the concrete mixed, placed and finished in the usual manner, the same as for plain floor surfaces. This surface was to be sprinkled with water two or three times a day for four or five days, and "must not be used for severe service for four or five days."

To determine the actual effect of this iron, when mixed with cement, briquettes were made of cement and of cement mixed with the iron, with the results shown in Table I.

TABLE I. TENSILE STRENGTH OF BRIQUETTES WITH AND WITHOUT IRON

(lb. per sq. in.)

	1 day neat	7 day neat	7 day, 1 to 2 Mortar
Portland Cement without Iron:	363	813	470
	342	837	480
	338	867	440
	Ave. 348	839	463

	1 day neat	7 day neat	7 day, 1 to 2 Mortar
Portland Cement plus 15% by Weight of Iron:	344	711	412
	365	795	412
	385	757	405
	Ave. 365	754 = 90%	410 = 88%

The boiling tests for all of the briquettes in Table I were satisfactory.

The comparative inconsistency in the 1-day neat tests might be explained by the probability that both adhesion and cohesion were effective in the case of the iron and cement briquettes. The adhesion to the glass of all briquettes containing the iron was very noticeable, indicating bonding qualifications.

To determine the effect of the iron when mixed with a 1:2 mortar and using 20% of iron per weight of the cement, the tests shown in Tables II and III were made for crushing and abrasion:

TABLE II. CRUSHING TESTS ON 2-INCH CUBES

(lb. per sq. in.)

No iron	20% iron
18860	16330
17000	16340
	16200
Ave. 17930	Ave. 16290 = 19%

TABLE III. RATTLER TESTS ON 4 INCH CUBES

360 REVOLUTIONS IN RATTLER

	No iron	20% iron
Initial weight of 3 cubes	15.6875 lbs.	16.1875
Final weight of 3 cubes	12.6875 lbs.	13.4375
Loss in Rattler	3.000 lbs. = 19.1%	2.7500 = 16.9%

There seems to be a material loss in tensile and compressive strengths and a slight gain in abrasive strength due to the admixture of this iron.

However, the observed results of actual floor surfaces where this material had been used seem to bear but little relation to the foregoing tests until the surface skin had once become marred or broken, when deterioration seemed to be more rapid and thus to confirm the test results.

A sample section of floor was laid to replace an ordinary 1:2 mixture surface coat which had been 1 in. thick and become badly worn. The old concrete was all cleaned out and the top of floor slab washed off and soaked for ½ hr., and then the surface was slushed with a bonding coat of the iron mixture as already described. Then a 1:2 mortar was prepared, using 15% admixture of iron, also as previously described. This concrete was spread before the bonding coat had time to set and floated twice, and then a dry mixture of the iron and cement mixed in about equal volumes and a sufficient amount was dusted evenly over the surface to require about 5 lb. of the iron per 100 sq.ft. of surface. This was carefully and evenly troweled and retroweled with a wooden tool, and the surface was finally brought to a hard smooth finish with a steel trowel; the rate of work being such that one expert finisher and a helper could complete 500 to 600 sq.ft. of surface per day.

This surface was kept continuously wet for a period of about five days and protected from traffic for ten days, after which it was carefully inspected and found to be well hardened, dense and smooth, with specks of oxidized iron all over the surface. It was then subjected to as severe traffic as possible and has continued to be so treated for a period of six months without any indications of deterioration, dusting or wear. About three months after it had been placed it was desired to obtain some samples of the work, and these were cut out with considerable difficulty, as the bond between the new and old concrete was found to be stronger than the cohesive strength of new concrete.

A close observance of the various operations involved in the laying of this sample floor, however, suggested that, first, there was a good bond with the old work, and, second, there was a good surface finish, and in these two features are centered the beginning of all floor troubles. It was immediately decided to make a series of test slabs ½ in. thick, but with varying amounts of the iron used in the body of the concrete and concentrated upon the surface and also to finish each surface to varying degrees of smoothness (or perfection). The concrete was all mixed in the proportions by volume of one of cement to two of sand and percentages of iron, based upon the weight of the cement used, were admixed as noted in Table IV.

TABLE IV

Specimen No.	Lower Layer Thickness	Lower Layer Per Cent. Iron	Top Layer Thickness	Top Layer Per Cent. Iron	Iron in lb. per 100 sq.ft. Dusted on Top
1	½ in.	15			40
2	½	0			40
3	½	15			10
4	½	0	¼ in.	15	5
5	½	0	¼	15	12
6	½	0	¼	15	25

The iron for dusting on top surface was always mixed with an equal or greater amount by volume of neat dry cement and dusted on as evenly as practicable after the first floating and preceding the troweling, and when the larger amounts were used it had to be divided into two or three applications, because the concrete would not take up the full amount all at once.

These slabs were kept damp for a period of seven days. Nos. 1 and 2 had received about the maximum amount possible of surface iron, and upon scraping same with a blunt steel edge the surface presented an almost continuous metallic lustre with depressions showing faint indications of cement. What little cement dust had flushed to the surface would be loosened during this scraping, and when washed off no more dust would seem to appear.

Nos. 3, 4 and 5 showed the same general appearance and wearing capacity as the floor sample already described, but the coloring was comparatively darker as the percentage of iron in the surface increased.

No. 6 presented a general appearance blending between the others and seemed to have as much iron as was or could be of any advantage.

In all cases the surface might be likened to a sort of skin which, when once broken or cut through, would continue to cut and grind from its own particles, and for this reason the rougher portions of the surfaces would break down under abrasion and wear away much more readily than the smooth sections. There was no discernible advantage from having the iron in the bulk of the concrete. In every instance where the iron mixture was against the glass of table it was necessary to pry the slab loose, leaving small pieces adhering to the glass.

Conclusions

Any extra precautions and expense should be concentrated in the *bond* underneath and the *finishing* of the *surface*.

A rough surface will not wear well under any conditions.

A smooth, dense surface is most serviceable and is more likely to approach perfection when some special element or remedy is used.

The addition of finely powdered iron dust to the surface promotes an improved finish and fullness of texture and bonds the exposed cement particles more closely together.

Eternal vigilance is the price of a good concrete floor surface.

The New O.-W. R. & N. Bridge at Portland, Oregon

By W. P. Hardesty*

There has just been completed across the Willamette River at Portland a new combination railway and highway bridge, built by the Oregon-Washington Railway & Navigation Co. This railway is one of the so called Harriman roads, on account of which the bridge is sometimes known as the Harriman Bridge. It is a double-deck bridge with vertical lift. It cost $1,700,000.

The new bridge replaces one built by the old O. R. & N. Co. in 1888. This bridge was the first steel structure to be constructed across the Willamette River, for which reason it has always been locally known as the "Steel Bridge." Like the new bridge, the old structure was a combination bridge with two decks, the lower one to carry the railway traffic and the upper one to carry highway travel. It was designed by the late George S. Morison.

Though designed to support the heaviest rolling stock in use at the time of its construction, it has in recent years been wholly out of date, and in 1910 work was begun on a new structure.

The old bridge crossed the Willamette at about its narrowest point in the city, where it is only 600 ft. wide between harbor lines. This is near the Union Depot. There was no room at the east end for a turn to the north, down the right bank of the river, and as the expansion of the railway company's system during the past year or two has included a line of traffic to Puget Sound points it became desirable to provide for such. The new bridge is located about 600 ft. upstream from the old one, by which arrangement the company secured room at the east end for a direct turn in either direction. A recess in the line of the high bench land bordering the river here, together with a design of bridge with diverging trusses, permitted use of 16° curves, for northbound traffic to Washington and southbound traffic to California.

The highway portion of the bridge starts on the west side at Third St. and follows eastward along and in Glisan St. to the river; thence by a deflection to the left it crosses the river nearly at right angles and ends on the high bench facing the river. The railway portion forms the lower deck for the three spans across the river itself. The highway deck has an approach on the west side of 738 ft., one on the east side of 305 ft., while the length over the three river spans (common to both decks) is 796 ft., making a total length of 1839 ft. The west approach has an up-grade of 5.98%, the east approach one of 2.5%, while the central (lift) span and portions of the adjacent spans are level. The approaches are of plate-girders supported by columns, except about 250 ft., at the west end, which is of concrete retaining walls filled in.

The distinguishing features of this structure are its very heavy construction and the arrangement for lifting the two decks of the lift span, either together or separately. The upper deck was designed for the heaviest city traffic, providing for loading with pedestrians over all, for continuous lines of street cars, for loading with the heaviest road rollers in various positions, etc. The lower deck was designed for the heaviest locomotives and cars used on the Harriman system, with double tracks.

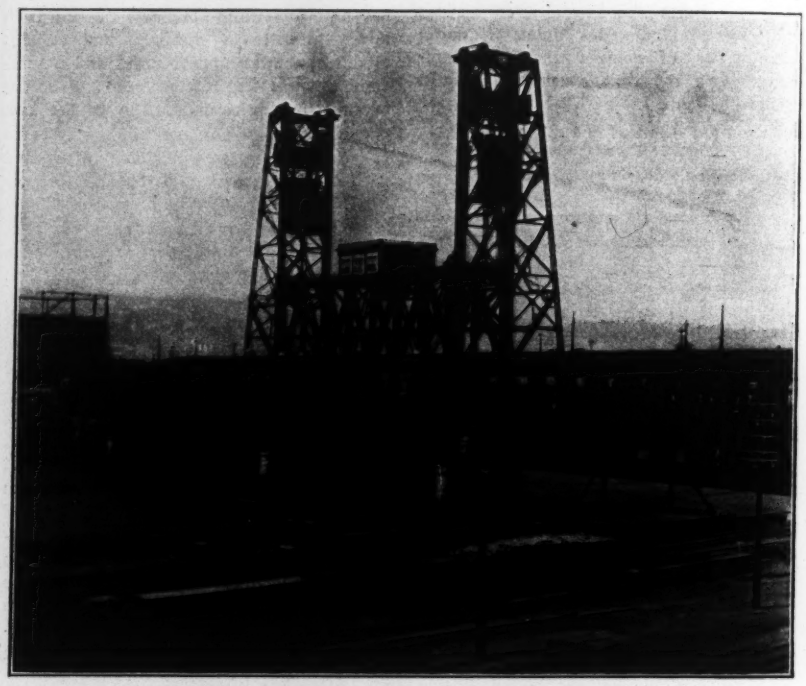


Fig. 1. New Double-Deck Lift-Bridge over Willamette River, at Portland, Ore.; Oregon-Washington Railway & Navigation Co.

The river part of the bridge consists of two fixed spans, each 287 ft. long between bearings, and a central lift span of 220 ft., all Pratt trusses. For the two fixed spans the highway deck is on top and the railroad deck along the level of the lower chords. The lift span rests on columns, placed on the piers, and it is a through span for the upper deck.

The depth of the trusses (c. to c. chords) is 59 ft. Some idea of the massive construction of the bridge may be obtained from the size of the members. The end diagonal posts are 42 in. deep by 39 in. wide. The lower chords are 42 in. deep by 36 in. wide, the adaptation to the different stresses in the different panels being made by varying the thickness of the metal. The floorbeams have a top-flange width of 18 in. The tower posts are 36 in. square.

For the lift span the trusses are spaced 34 ft. on centers. For the east span the distance is 34 ft. at the river end and 71½ ft. at the short end, the divergence allowing for the curving of the railway tracks to the north and south respectively. For the west span the widths are 34 ft. at the river end and 42 ft. at the shore end. The latter width is sufficient, as but one turn, that to the northward, to reach the Union Depot, is needed. This is done with a 16° curve.

Piers

Of the four piers in the river, two are practically at the shore line. All are of concrete throughout. The pier at the west shore was founded on piles driven to a great depth, for which reason a coffer-dam was used in the construction. The bed of the river changes from a deep alluvial deposit on the west side to an exposed cemented gravel at the east side.

The two channel piers were set by open dredging, as the depth was too great for use of the pneumatic process. Each is supported by a crib 36x72 ft. filled with concrete. The cutting-edge of the crib for the west pier is 123 ft., that for the east pier 113 ft., below extreme low water. The top of coping of piers is 22 ft. above low water. Both piers were set several feet deep in cemented gravel, which had to be broken

*60 E. 31st St., N., Portland, Ore.

up by drilling and blasting. A charge of about 30 lb. of dynamite was ordinarily used, set off in the bottom of a hole made by drilling and casing. The greatest river depth is shortly east of the east pier, about 80 ft. at low water and 100 ft. at high water.

The cost of the substructure work was about $600,000.

Superstructure

The lower deck has a clearance of 26 ft. above low water and 5 ft. above high water; base of rail is 6 ft. higher, and the upper-deck level is 52½ ft. above this.

for automobiles; an 11-ft. roadway on each side for horse vehicles; and on the outside a sidewalk of 6-ft. clear width at each side of the structure. The projecting floorbeams serve as cantilevers for nearly all the sidewalk space, and over part of the bridge for the roadways also; the irregularity in this is due to the divergence of the trusses. Because the trusses of the lift span lie above the upper deck, a space of about 5 ft. is taken by each truss and the adjacent guard timbers, so that on this span the roadways (lying outside of the trusses) are materially narrowed. On the two fixed spans the width of each roadway

243 ft. high above pier, consists of two tower posts resting on the pier, and two inclined back legs resting on the top chords of the fixed span. The two sets of legs are thoroughly braced together at intervals, and the 20-ft. space at top between main leg and back leg is spanned by a girder. On the girder are placed the two 6⅓-ft. sheaves on which run the cables connecting the lower deck with its counterweights. The two sheaves on each girder are 16 ft. apart on centers. The height from low water to center of sheaves is 265 ft.

The main or upper deck is lifted by cables passing over one 14-ft. main

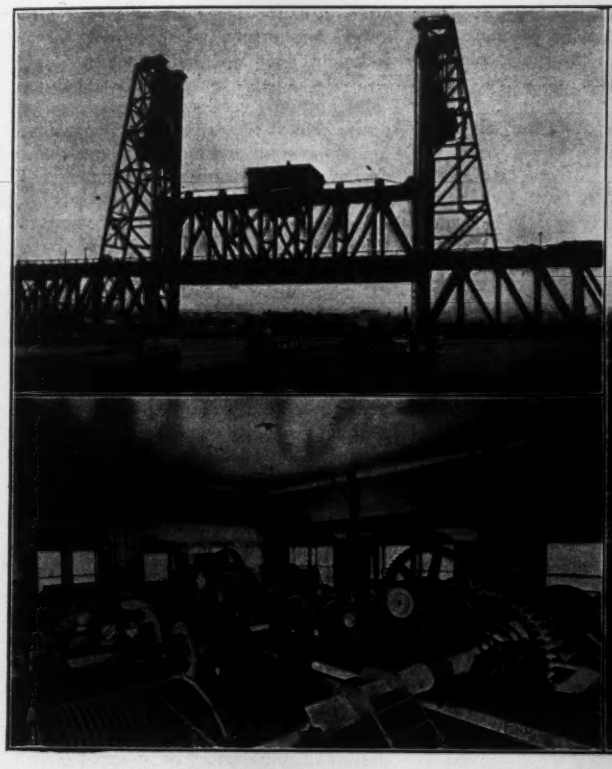


Fig. 2. Lift-Span, Lower Deck Raised
(Machinery house is on top of span.)

Fig. 3. Interior of Machinery House

Fig. 4. View along Top Chord from Machinery House Toward Tower

The lower deck has a separate lift of 46 ft., making a clear height of 72 ft. above low water without moving the upper deck. The upper deck has a lift of 93 ft., so that when raised with the lower deck also in raised position, the total lift of the lower deck is 139 ft., and the total clearance is 165 ft. above low water and 144 ft. above high water. This clears the highest-masted vessels entering Portland. With the lower deck alone lifted, all but the largest of the steamboats plying the river can pass, at ordinary stages of water.

Roadway—The upper deck is divided into five parts: a 28-ft. central section for the double-track street railway and is 15 to 16 ft., as no space is taken by the trusses.

The roadway and car-track spaces are paved with wood blocks, treated with 10 lb. of creosote. These are placed on tarred paper which rests on a floor of 4-in. plank, laid in turn on 7x9-in. ties, all treated with 10 lb. of creosote. The floor covering of the 6-ft. wood sidewalks is not treated.

Lift Span

The vertical lift span is much the heaviest of that type so far built.

At either end of the lift span is a steel tower, resting on the pier and on the end of the adjacent fixed spans. Each tower,

sheave at each side of each tower. The centers of these sheaves are 245.6 ft. above low water. Each sheave weighs 24 tons, but, as the boxes were attached before hoisting, the weight to be lifted was 35 tons. These main sheaves rest on brackets offset inside of the tower posts.

In each tower is a single main counterweight, made of concrete, weighing 1,712,500 lb., of overall dimensions 40 ft. high, 29⅚ ft. wide transverse to the bridge, and 10⅓ ft. thick. These counterweights were built in place around a steel framework. At the corners are projecting guides to engage the fixed guides on the tower. Near each end a riveted

hanger extends from the bottom to an offset 8 ft. below the top, connecting by a 10-in. pin to the equalizers by which the cables are attached.

The lower deck has separate counterweights, which were cast in sections at convenient places on the main deck, then hauled up to the towers and hoisted into position. For the purpose of closer adjustment a large number of concrete weights of one cubic foot size were cast, which can be added either to the large counterweights or to the lift span, as required.

The equalizers of the main counterweights are equal-armed levers in four tiers, giving a separate lever end for each of the 16 cables at each tower. These levers were cast of steel, and then annealed. Before leaving the factory the ends of the 2⅛-in. cables were passed through holes in the jaws, beyond which the wires were untwisted and made straight, and then doubled back into the conical hole and the latter filled with babbitt metal.

The counterweights are hung in the towers themselves. Each one hangs over the end of the fixed span, on the back side of the forward tower posts. The 16 cables from each end of each counterweight pass up over their main sheave and thence down to attachment at end of the lift span. They are fastened directly by jaws to pins in top of a cross-beam that connects the ends of what are practically hanger columns, though appearing to be vertical end posts of the span.

The lower deck of the lift span is separately movable. It is suspended from the main span, and when down is 52½ ft. below the main deck, the latter being near the level of the lower chords of the trusses. The lower deck is practically a continuous girder; a lift is required at each panel-point, but it is so stiffened longitudinally that a lack of close adjustment of weights at the panel-points is of little consequence. It is of very heavy steel-girder construction. There are eight panel-points (counting the end ones) on each side of the deck, so that 16 points of support are required. The computed weight required in the individual counterweights of a set of four was as follows:

1st weight (end panel-points)	62,400 lb.
2nd weight	134,140
3rd weight	139,240
4th weight (panel-point next to center)	145,360
	481,140 lb.

The total weight of the two sets is 962,280 lb., which is the weight of the deck and suspending attachments.

The four counterweights in each set are separated about 1 in. clear, so that they hang independently of each other. They are of concrete on steel frames. Attached to equalizers at each end is a set of four 1¼-in. cables, that pass up to the sheaves on top of the tower before described. These counterweights normally hang above the main counterweights, but in descending they pass back of the latter. The cables (14 to each end of each set of four weights) pass over the sheaves and down to a drive sheave resting on the top chords of the lift span, from which they pass to the proper panel-points. The cables for the end panel-points (running from the smallest counterweight) are only two to each panel-point, but there are four for each of the remaining three panel-points of the set.

The lower deck is suspended by hanger columns, attached to its panel-points, passing vertically up through the corresponding columns of the main span. The cables before described are attached to the tops of the hanger columns, and likewise pass through the main columns. When the lower deck is lifted to its

FIG. 5. ATTACHMENT OF COUNTERWEIGHT TO CABLES

limit, the point of attachment of the cables is just below the top chords of the span, as the hanger columns are then telescoped in the main columns. The hanger columns, when down, are supported by pins resting on seats built near the foot of the main columns, and are locked down by cams which prevent vertical motion. The cams are driven by electric motors, and a system of electric lights on a board in front of the operator's stand indicates whether they are drawn or driven.

OPERATING MACHINERY

On top of the lift span is placed the machinery for operating the decks. Its total weight is about 450 tons. The machinery house is located at the center of the span, and covers the full width between the trusses. The operator's room is suspended underneath this house, so that he can observe the main deck as well as the river traffic.

The machinery for operating the lower deck is driven by two 200-hp. motors placed on the downstream side of the house, and that for the upper deck by two 200-hp. motors placed on the upstream side. However, through a common shaft either set of motors can be made to operate either deck.

For the operation of the main deck an arrangement somewhat similar in principle to that used on the Hawthorne Ave. Bridge across the Willamette* is used. A multiplication of power through three trains of gear wheels connects up to the main-drive sheave, on which the 1⅛-in. operating cable is wound. From this sheave twin cables lead out along the span to underneath another sheave directly under the main sheave on the tower, and thence up to a point of attachment near the main sheave. A pull on these cables lifts the span. The other ends of these cables (coming from opposite side of the drive sheave) pass over the sheave at end of span and thence downward to a point of attachment near the bottom of the tower post, where a turn-buckle is provided for adjusting the slack. A pull on these cables, of course, lowers the span. There are four sets of main drive sheaves and of cables, corresponding to the four main sheaves for the main deck.

To operate the lower deck, the shaft driven by the motors connects by bevel gearing with a solid 5¾-in. shaft running out to the end of the span (one to each end) which drives by bevel gearing another shaft transverse to the bridge, at each end of which is a drive sheave. The 14 cables coming down from the sheave at top of tower pass under this sheave (except the two which go directly down to the end panel-points of the lower deck), and thence forward over the sheaves located over the panel-points. The four cables for each panel-point lead down from the respective sheaves to the attachment to the hanger column. Operation of the drive sheave, as before described, thus raises or lowers the deck. There are four sets of these sheaves, corresponding to the four sets of the towers.

In the operator's room is the mechanism for locking and unlocking the lift spans. The cams for locking down the lower deck lock automatically, but are unlocked by a special mechanism driven by a small motor. A weighted lever holds the cam in the locked position, and unlocking is accomplished by a magnet located behind the cam, which pulls it back when actuated by the motor. The locking down of the lower deck is considered very important, so that there is full justification for the elaborate mechanism used at each panel-point. The locks can also be operated individually by hand, by levers at each one on

*Described in Engineering News, March 9, 1911.

the main deck. The lower deck has also two locks at each end, driven by a motor located underneath and resting on the piers. These locks are also controlled by the operator.

The main deck also locks automatically at each end, but is released by the operator turning a wheel on a vertical stem.

In addition to the operator, a watchman is employed on the lower deck. This watchman has communication with the operator by electric signals. He signals the operator when he wants to let a train through, and when it has passed. In the middle of the span, on both the upstream and the downstream sides, and fastened on the outside of the lower deck, is a semaphore with four lights, two of green and two of red. The two lower lights (one red and one green) indicate to the river traffic regarding the lower deck, and the upper ones indicate regarding the upper deck.

The operator sets the railway semaphores (one at each end of the bridge) for clear (or otherwise) as regards train traffic. He is the judge of the need of lifting the span for the river traffic, and the height to which to raise.

In operating the main lift, when it ascends to its limit the main counterweights descend to within about 3 ft. of the floor of the bridge. As the trolley wires for the street car line over the bridge have to be passed, a special arrangement is used. A section of some 15 ft. in length of each wire is replaced by a movable strip. From the top of this strip small cables pass up over sheaves to small weights, which normally hold the strip up. When the counterweight descends, it forces down the strip (a groove being formed in underside of the concrete to fit over the strip and preserve its correct alignment), and on the ascent the weights cause it to follow. At the ends of the strip, pieces of copper bar form the conductor, and the ends of these are cut to a long bevel to contact with similar bevels in the copper bars at ends of the fixed sections of the trolley wires.

To supply electric current to the motors on the lift span when it is being raised, there are two vertical trolley wires placed about 3 ft. apart, fastened to the end of the fixed span, on which run short trolley arms attached to the lift span.

Erection

The construction of the superstructure of this bridge was a most formidable undertaking. The channel had to be kept open at all times for boats, including high-masted sailing vessels. The great weight of the lift span, the fact that it was to be supported on columns far above the water, and the comparative swiftness of the current at this place, made it appear too difficult to build the span on scows and float it into position, as was done with the Hawthorne Ave. Bridge.

The steel for the superstructure was fabricated by the American Bridge Co., but the erection was a separate contract. So difficult appeared the task that only one contractor ventured to bid on the work. The contract was taken by Robert Wakefield, of Portland, at unit-figures that gave an estimated cost of $232,000. The erection was taken at a unit-price per ton of metal placed, and the contractor also supplied the lumber for the sidewalks and the machinery house and the attendant's sheds, and also the tarred paper under the wood-block pavement.

Work was begun on the superstructure about Apr. 1, 1911.

The two fixed spans were erected by use of an A-frame placed on a scow in the river. This frame was 110 ft. long, composed of two legs forming an A, the legs spaced 34 ft. apart at the bottom and 1 ft. at the top. Each leg was made by fastening two 112-ft. fir piles together at their ends, and then jacking them apart between, forming a double bow with 7 ft. maximum distance between centers. Double cross-bracing was used every 10 ft., and 1¼-in. iron tierods were also placed at the panel-points so formed. These rods were particularly needed when a heavy load was being hoisted, as the longitudinal compression tended to force the two timbers apart. The two legs of the frame rested on a longitudinal piece on the scow, and a special bearing was cut out so that each leg had a full circular bearing for different inclined positions. The frame lifted pieces weighing 45 tons.

The falsework for the lift span consisted of a four-truss Howe span resting on cantilever supports sloping upward and outward from the piers, which reduced the required length of truss span. Each arm consisted of four sets of five legs each, there being a set under each of the Howe trusses. The five legs varied in inclination from vertical to about 30° off the vertical; each consisted of two to six lines of 12x12-in. timbers. The legs footed directly on the pier, and each set was anchored back to the fixed span by ten 2-in. to 2½-in. iron rods. The top of the cantilever arms was 110 ft. above low water, but by cribbing up for the supports of the Howe trusses the latter were made to clear low water by 115½ ft., which answered for all but one or two sailing vessels, and these had to remove their topmasts.

The Howe trusses were 120 ft. long by 24 ft. high; top and bottom chords of three lines of 7x16-in. timbers; diagonals of 8x12-in. timbers; posts of 10x12-in. timbers. The trusses were erected in two pairs, the two of each pair being 9 ft. 8½ in. apart on centers. Each pair was located to come under the steel truss above; the outside trusses thus were 44 ft. apart, out to out. These temporary trusses were built on scows and were floated singly out to the channel span and lifted into position by two derricks with 110-ft. booms, one derrick set on each fixed span. The weight of each Howe truss was 43 tons.

The Howe-truss falsework being in position, the next step was the erection of the main traveler on top of the Howe trusses. The traveler was of the ordinary type of gallows-frame outside traveler; and comprised two timber bents spaced about 40 ft. apart. Its total height was 103 ft. above the falsework and 96⅓ ft. above the bottom chords of the steel trusses. Its inside width was 41 ft., and the extreme width on top about 76 ft. It was built of 12x12 and 10x12 timbers, with 4x10 braces in the panels, the girts being spaced 9⅓ ft. apart vertically. The weight of the traveler was about 60 tons. The heaviest pieces handled by it weighed about 35 tons.

The traveler was used in erecting the lift span and parts of the towers. To reach the tops of the towers, a 150-ft. gallows frame or sheer leg was set on top of the Howe-truss falsework. The two posts of this frame, spaced 34 ft. between centers (which conformed to the spacing of the steel trusses), were built up of two 12x12 timbers, bowed to 9-ft. spread at the center and well cross-braced. In working position this sheer leg was inclined some 25 or 30 ft. from vertical, so that its top was something less than 290 ft. above low water. Each leg footed on an oak block, hollowed or cupped out so as to fit the rounded end of the leg in all positions, and resting on a longitudinal timber which distributed the weight along about 50 ft. of the Howe truss. The weight of the frame was about 40 tons. The heaviest load it was called on to lift was 42 tons, this being the top section of the main tower post.

The sheer-leg was erected by the traveler, and was itself used to erect the upper parts of the towers and to place the sheaves for the counterweights. It worked inside of the traveler and clear of the latter. The traveler shifted the sheer-leg from one end of the falsework to the other when the first tower had been completed; in this transfer the sheer-leg was let down flat.

The operations in erecting a tower were as follows: With top of the sheer-leg reaching over top of the tower, a ¾-in. fall line ran from a 6-sheave block at the top of the sheer-leg down to a 5-sheave block on a scow that was anchored in the river below, either above or below the bridge, as most convenient. The hoisting engine was located on this scow. The other end of the fall line ran down through the tower to the lower deck of the bridge on the fixed span, where the material was taken directly from railroad cars. The inclination of the sheer-leg was controlled by a ⅝-in. back line passing over a 4-sheave block at the top, which was connected with a

4-sheave block anchored to the falsework at a sufficient distance back; the other end of the back line passed back to a hoisting engine placed on a derrick frame on the fixed span on the opposite side of the channel from the tower being erected. A length of 2600 ft. of cable was used in the fall line and 2300 ft. in the back line.

The delivery of the construction material for the lift span was accomplished by use of a temporary tramway built on the main deck on the fixed spans to the east of the lift span. The material was hoisted from the railway sidings on the ground on the east shore, over the side of the bridge and thence up to a home-made flat car on the trestle some 25 ft. above the deck. From this point the tramway ran on an up-grade of 7 or 8% to connect with the Howe-truss falsework over the channel. The cars were hauled up this incline by a ⅞-in. cable reeved through a set of sheaves, connected with a hoisting engine. The heaviest pieces handled were some of the chord members of the span, weighing 34 tons each.

It was first contemplated to use an aërial tramway for this work, starting on the floor of the east-side deck and running up on a 20% grade to deliver the materials on the falsework, but this plan was abandoned.

The Howe-truss falsework was intended to support a load of only about 1000 tons, distributed. The estimated weight of the completed lift span, with its machinery, is about 1750 tons. A portion of the load came directly on the cantilever arms through the use of wood posts. After the main members of the trusses were in position and riveted, the main counterweights were used to counterbalance the weight sufficiently to allow completion.

Each counterweight was built on a bed of sand 13 in. thick, formed by adding timber sides to the platform supporting the counterweights. The platform was supported by pile timbers placed on top of the piers. The main cables were placed in position and the respective ends attached to the counterweight equalizers and to the lift span, with the slack taken out as far as possible. It was planned to begin utilizing the counterweights when their weight and that of the steel placed in the span should each amount to about 1000 tons. At that weight the load placed on the Howe trusses had almost taken out their camber of 2½ in., and the tops of the timber posts supporting the counterweights were beginning to crush. It was calculated beforehand that 8 in. would take out the slack in the cables and 4 in. to 5 in. more the stretch of the cables due to load. When all was ready, the sand was gradually let out through holes in the bottom of the platform. With 10 or 11 in. subsidence the counterweights were clear, and as they were found not heavy enough to lift the span they were built up higher.

The wedges and blocking were then knocked out from between the bottom chords of the steel trusses and the top chords of the Howe trusses, so that the latter became free. The cross-bracing was taken out, and the Howe trusses were lowered to the river by fall lines attached to blocks fastened to the top chords of the lift span and operated by the hoisting engines. The work on the counterweights and the lift span was then carried on to completion, but partial support under each was maintained to the end, that under the span being formed by the falsework bearing on the cantilever arms.

This difficult piece of bridge erection was done under charge of Charles N. McDonald, superintendent for the contractor.

Engineers and Contractors

The bridge was designed by the firm of Waddell & Harrington, consulting engineers, Kansas City, Mo. The immediate erection was in charge of C. K. Allen, resident engineer. The plans were approved by John D. Isaacs, consulting engineer for bridges on the Harriman system of railroads. The railroad management went out of its usual practice of employing only its own engineers in this one case. The lift span here used is of a patented type, invented by Waddell & Harrington, and their fee of $90,000 for design and supervision of erection of the bridge included also the royalty. The erection was, to a certain extent, also supervised by the engineering department of the Oregon-Washington Railroad & Navigation Co.

The Howe-truss falsework, the traveler, and the sheer-leg, were designed by George T. Forsyth, engineer of bridges on the staff of George W. Boschke, chief engineer of the railway. The railway company made the preliminary soundings and borings.

The contractor for the substructure was the Union Bridge & Construction Co., of Kansas City, Mo. The erecting of the superstructure was done by Robert Wakefield, of Portland.

Highway Rental

The upper deck of the bridge, designed for vehicle, pedestrian and street-car traffic, was, of course, not needed by the railway company itself, but it was a condition of the grant to build the bridge and its approaches. A controversy between the railway company and the city as to the proper rental for use of the upper deck finally resulted in a reference of the matter of first cost of the upper deck to engineers selected by the respective parties—Waddell & Harrington for the company and Ralph Modjeski for the city. The railway company maintained that a rental equal to 5% of the cost of the deck was proper, inasmuch as both the interest and depreciation were to be considered, the useful life of the bridge being estimated at 33 years. The cost of the upper deck was placed by the company at $775,000. The rental to the street-railway company was fixed at $1500 per month, the city to pay the balance of about $1700 and also to pay the wages of the gatemen and the cost of repairs and renewals to the floor.

The engineers appointed as above went very fully into the cost of the bridge, and submitted a report with the following cost figures:

Highway	
Approaches	$300,000
Highway part of main or river portion of bridge	521,000
Total highway portion	$821,000
Railway part of river portion of bridge	$833,000
Railway approach	50,000
Grand total	$1,704,000

The railway company was thus shown to be entitled to more rental than it had claimed, as the agreement between the parties was that 5% rental should be allowed on the ascertained cost. The company also put in an additional claim for rental of land owned by it and occupied by the approaches, bringing the total yearly rental to $45,356, but by a concession made the rental was fixed at $44,000, for which a contract was signed.

The rental paid to the city by the street railway company for its use of the bridge is $18,000 per year.

A Water-works Decision settling a dispute as to the ownership of house service connections was handed down by the Supreme Court of Louisiana on Nov. 17. The court decides that when a municipalty operates a water-supply system it is to be considered in the same light as a public service corporation. The case reviewed was that of a citizen of the city of Meridian vs. the city, on account of an inadequate supply of water furnished the appellant. Prior to the acquisition of the plant by the city the appellant had laid a supply pipe from the main to his premises. After the city assumed control complaint was made to its officers that the supply of water was inadequate. The city refused to remedy the trouble, contending that any defect that existed was in the supply pipe from the main to the appellant's premises, and that the city was under no obligation to remedy such defects. This contention was upheld by the lower court, but the Supreme over-ruled this decision and declared that when the city took over the water-works it found the connection installed and continued to supply water, taking tolls for the service. The test is in the location of the defective pipe. The city is responsible for the upkeep and continued efficiency of the pipe in the street and is responsible until the connection reaches the property line. The owners of abutting property have no right to go upon and excavate the streets of the city, and the fact that the appellant claimed ownership of the pipe does not change or affect the rights and duties of the parties.

Imhoff Tanks and Percolating Filter in Operation, Atlanta, Ga.

By Wm. A. Hansell, Jr.*

The accompanying views of the Proctor Creek sewage-treatment plant, Atlanta, Ga., supplement the article on the sewage works for that city then under construction, contributed by the present writer to Engineering News of Mar. 14, 1912. The Proctor Creek plant was described as typical of the three separate Atlanta plants made necessary by topographical conditions. Fig. 1 shows the Imhoff tanks in use. It will be noted that there is no scum on the tanks. Fig. 2 shows a sprinkling filter in operation with the upright ventilating pipes and their vane-controlled cowls. Figs. 3 and 4 (same samples in each case) show the sewage before and after passing through the Imhoff tanks. The relative clearness of the effluent (sample glass on the reader's right in each case) as compared with the crude sewage is notable.

The photographs here reproduced are the first ones, showing the results of operation, to be sent out. This plant was started up about Aug. 1. The sludge in the Imhoff tanks will soon be ready for withdrawal. The broken stone composing the sprinkling filter is just beginning to show bacterial growth.

Details of the design of the plant were given in the article already mentioned. For convenience, it may be restated that the Proctor Creek plant is the smallest of the three undertaken by the city, having a rated daily capacity of 3,000,000 gal., as compared with 5,000,000 gal. for the Intrenchment Creek plant and 8,000,000 gal. for the Peachtree Creek plant, each of which is still under construction.

The Proctor Creek tanks are 25 ft. in diameter and 26 ft. in depth, with a depth of 10 ft. between the slot connecting the upper and lower stones and the bottoms of the tanks, making, at the 3,000,000-gal. rate, the sewage three hours in passing through the tanks.

Before the sewage reaches the Imhoff tanks at Proctor Creek, it receives a rough screening, passes through a sand pit and then through grit chambers. The effluent from the Imhoff tanks is passed through a fine screen (36 meshes per in.), run by electric power, before it goes to the filters.

The sand pit at the Proctor's Creek plant has been added since the beginning of operation, because more sand came to the plant than was anticipated. The system of sewers in Atlanta in the territory draining into this plant is the combined and during storms there is quite a large quantity of heavy sand carried to the plant which we find it more satisfactory to take out in the sand pit by flushing than to take out of the grit chamber by manual labor.

As to progress on the other two plants, it may be noted that the Intrenchment Creek plant is only well begun and it will probably be a year before it is put in operation. The broken-stone situation is such that there is considerable speculation as to how long it will take to get enough of the proper size for the filters. The Peachtree Creek plant is nearly complete except for the filter stone in an acre and a half of the beds. The contract time for the completion of this plant is Dec. 31 of this year, but the same condition exists as to the filter stone as at the Intrenchment plant.

*Assistant Engineer in charge of sewers, Atlanta, Ga.

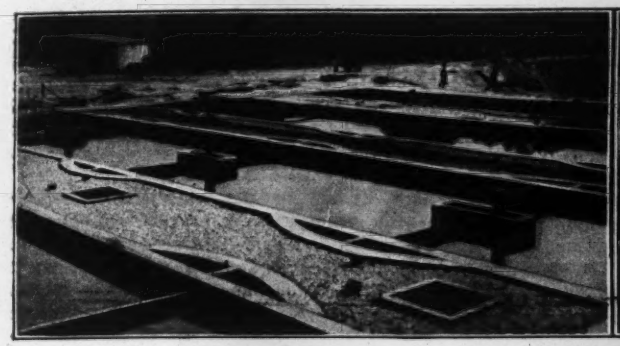
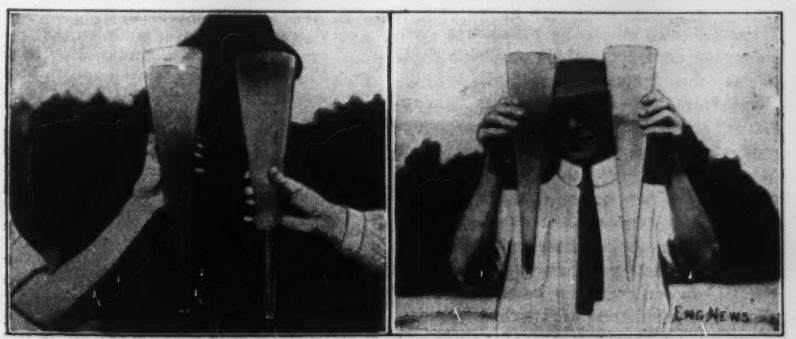


Fig. 1. Imhoff Tanks

Fig. 2. Sprinkling Filter

Figs. 1 and 2. Imhoff Tanks and Sprinkling or Percolating Filter in Operation at Atlanta, Ga.



Figs. 3 and 4. Crude Sewage and Effluent from Imhoff Tank, Atlanta, Ga.

(The views show the same glasses and the same contents. Fig. 3 was taken with a black background to bring out the marks on the glasses and to show how much the settlement was, while Fig. 4 was taken on a white background to show more clearly the contents of the glasses.)

A Wireless-telegraph System of transoceanic scope is being planned according to press dispatches to connect Paris with various French colonies and with North and South America. The project as laid before the French Chamber of Deputies, according to the reports, contemplates the expenditure of $4,000,000 total, and about $1,300,000 of this in 1913. Only stations in the South American-Pacific girdle have been named, including Morocco, Senagal, Martinique, Marquesas Island, Tahaiti, Noumea (New Caledonia), Saigon and Indo-China.

Electric Traction on two Mountain Divisions of the Denver & Rio Grande R.R. is to supplant steam according to published announcements. The first section will be 114 miles in the Wasatch Mountains, between Salt Lake City and Helper, Utah. The second section will be in Colorado, over Tennessee Pass, between Salida and Minturn, 87 miles. Other sections will be converted until the entire line is under electric traction. Power is to be secured from the Utah Utilities and the Central Colorado Power companies.

Letters to the Editor

Earth and Rock Slides at Panama, and Elsewhere

Sir—In ENGINEERING NEWS of Nov. 21, 1812 (p. 954), the statement is made that "Over twice the amount of material yet to be removed to complete Culebra Cut (= 2 × 9,500,000 cu.yd. = 19,000,000 cu.yd.) has already been taken out from slides, and about 45% of the excavation remaining to be done is due to them."

To the wayfaring man it would appear that by the time the water is let into the Culebra Cut, and thereafter, 100% "of the excavation remaining to be done" will be due to slides, in the natural course of things, mundane and terrestial.

Most of your readers would like to know what is the percentage contained in slides, referred to the originally intended volume of excavation? From the data gathered in the course of desultory reading, I make this about 17%, for intended side slopes of 1:1½, above the water channel in the Culebra Cut, 8½ miles long; and about half that percentage, 8½%, reckoning for the whole canal, 45 miles long.

On a memorial tablet erected to commemorate the completion of the Chesapeake & Delaware Canal in 1829, it is stated that: "On the deep cut more than 375,000 cu.yd. of earth slipped from the regulated slopes of the sides and passed into the chamber of the canal." As the "excavation from deep cut" is given as 3,500,000 cu.yd., we have here an example, in our own latitude, and in the time of our fathers or grandfathers, of slips or slides amounting to 10.7%.

"2 WALL STREET."

Nov. 29, 1912.

[The figures given in the article of Nov. 21 were taken from the *Canal Record* and are approximately correct; they may be verified by reference to the Annual Report of the Isthmian Canal Commission for 1911-12, recently issued. On page 145 of the report it is stated that on July 1, 1912, there remained to be excavated, inside the canal prism (Central Division or Culebra Cut), 8,184,540 cu.yd., of which 3,595,000 cu.yd., or 44%, were due to slides and breaks. There were slides subsequent to July 1, which accounts for the increase in both totals, the percentage remaining approximately the same.

The total excavation up to July 1, 1912, for the Central Division, was 94,544,885 cu.yd. Of this total the amount due to slides was 16,671,000, or 17.63% of the total. Deducting the material brought in by slides, the total would have been 77,873,885 cu.yd., which makes the amount of excavation due to slides 21.4% of the amount originally necessary for the canal prism. These ratios were given for a later date than July 1, in our issue of Oct. 3, p. 607, in an article on the cost of slides and breaks in cubic yards of excavation.

The original estimate of the Board of Consulting Engineers in 1906 placed the grand total of excavation for the entire canal prism at 103,795,000 cu.yd. Changes were subsequently made, the channel enlarged at places, notably in Culebra Cut, where the bottom width was changed from 200 to 300 ft., the location of the Pacific locks moved inland and other changes which brought the estimate up to 174,666,595 cu.yd. Of that, however, 7,929,493 cu.yd. were allowed for slides, so deducting this we have 166,737,102 cu.yd. Slides involving 20,000,000 cu.yd. have therefore added, at the present time, about 12% to the amount of material it would have been necessary to excavate for the entire length of the canal had there been no slides at all.—ED.]

Liability for Patent Infringement in Contracts

Sir—I have read with interest your editorial regarding the liability of contractors for patent infringement on page 1018 of your issue of Nov. 28.

The principal idea in making contractors liable for patent infringement is that if the contractor buys his materials, tools, etc., from the patentee he will be protected, whereas if the owner makes himself liable, unless he prescribes from whom the contractor shall purchase these things, the contractor is liable to purchase from whoever will sell the cheapest, regardless of whether that party pretends to have any interest in the patent or not, in which case the owner might become liable for heavy damages merely to save the contractor a small sum. I think that, in the vast majority of cases, if a contractor purchases his supplies, etc., from responsible concerns which claim to control the patents they will protect him against any suit for infringement, at any rate any businesslike contractor would have a written agreement to that effect with the supply-man before purchasing anything from him. If the patents on the work that is desired are so complicated that nobody is willing to guarantee the contractor against litigation, it might be possible for the owner to arrange directly with the alleged patentee and protect himself by such guaranty, bond, etc., as might seem advisable; but for the owner to agree in advance to protect the contractor against infringement suits without first protecting himself against the ignorance, stupidity, sharp practice, etc., of the contractors and others is, in my opinion, a very unwise thing to do.

There may be cases in which alleged inventors make a practice of continually harassing small contractors by threats of infringement suits, etc., based on patents of questionable validity, in the hope of levying blackmail on the contractors or obtaining extortionate prices from the owners. In such cases it would be well if some strong purchaser like a county or a city could be involved in this litigation and fight out the question of the validity of the patents to a finsh, but it may be very difficult to do so.

WILLIS WHITED.

Harrisburg, Penn., Nov. 30, 1912.

Notes and Queries

Several errors in the article "Wing Abutment Formulas," in our issue of Nov. 21, 1912, are to be corrected as follows:

In Fig. 1 the angle in plan between top and bottom edges of front batter is marked θ; it should be marked ϕ. In Fig. 2, the distance AF is marked both 18″ and 18″—B sin θ; the latter is correct, and the 18″ dimension should cover the distance AH. In the second column of the article, 14th line from bottom, the text should be corrected to read

angle IKJ = HAC = $\theta - \phi$

In the article "Structural Steel Poles and Towers," by R. Fleming, in our issue of Nov. 28, the cuts designated as Fig. 1 and Fig. 2 were transposed. This interchange is evident on reading the descriptive matter accompanying the true Fig. 1, the reference letters mentioned being seen in the cut marked Fig. 2.

Branding of Steel Pipe is now being successfully done, it is claimed, by the National Tube Co., of Pittsburgh, on all of its welded products. At regular intervals on each length the word "National" is rolled in raised letters. The exception is in the case of the smaller butt-welded sizes where this scheme is not mechanically feasible. Such pipe branding is a method of designation which has been greatly desired by pipe users for many years, but a number of difficulties have interfered with the formation of a completely satisfactory mark.

Issued Weekly by the
Hill Publishing Company
JOHN A. HILL, Pres. ROB'T MCKEAN, Sec'y.
505 Pearl St., New York.

Monadnock Bldg., Chicago.
6 Bouverie Street, London, E. C.
Unter den Linden 31—Berlin, N. W. 7.

CHARLES WHITING BAKER, Editor.

Subscriptions payable in advance, $5.00 a year for 52 numbers, including postage in the United States, Mexico, Cuba, Porto Rico, Hawaii, or the Philippines, $7.00 in Canada.

To foreign countries, including postage, $9.00 or its equivalent, 36 shillings: 36 marks: or 45 francs.

Notice to discontinue should be written to the New York Office in every instance.

Advertising copy should reach New York Office by Thursday of week before date of issue.

Entered at New York Postoffice as mail matter of the second class.

CIRCULATION STATEMENT

During 1911 we printed a total of 931,958 copies.

Of this issue, 19,000.

None sent free regularly, no returns from news companies, no back numbers.

Contents

	Page
*The Trafford Park Industrial District	1077
*The Inland Port of Manchester	1079
*A Concrete Mixer of a New Type	1085
*Notes on the Operation of the Cement Gun; Otto J. Swensson	1086
The Federal Water-Power Policy; M. O. Leighton	1088
*The Reduction in the Cost of Electric Lighting Abroad	1091
A German Code of Fees	1092
Land Reclamation by Drainage	1094
The Effect of Hydrogen Sulphide on the Concrete of Sewage Disposal Plants; Wm. M. Barr; R. E. Buchanan	1095
*Four Concrete Viaducts at Fort Worth, Texas	1097
*A Quadrant Crane for Motor Trucks	1098
Investigation of a Compound for Producing Dustless Concrete Floors; Albert C. Arend	1098
*The New O. W. R. & N. Bridge at Portland, Ore.; W. P. Hardesty	1100
*Imhoff Tanks and Percolating Filters in Operation; Atlanta, Ga.; Wm. A. Hansell, Jr.	1105
LETTERS TO THE EDITOR. Earth and Rock Slides at Panama and Elsewhere; "2 Wall St."—Liability for Patent Infringement in Contracts; Willis Whited—Notes and Queries.	1106
EDITORIAL. A Reckless After-Dinner Remark—A Schedule of Fees, and Rebating—The Creation of an Inland Seaport—Some Points About the Federal Government Water Power Policy.	1107
ENGINEERING NEWS OF THE WEEK	1114
PERSONALS	1115
ENGINEERING SOCIETIES	1116
ENGINEERING LITERATURE	1117

*Illustrated.

Engineering News

According to an announcement by the U. S. Geological Survey, the present exact value of gold is $20.671834625323 per fine ounce. Why the computer stopped at twelve places of decimals is not stated.

A Reckless After-Dinner Remark

Profiting by the memories of many weary hours passed in listening to dreary after-dinner speeches, the General Contractors' Association at its annual dinner at New York City, this year, proscribed all formal speaking and the members settled themselves at table without anticipatory regrets. It appears, however, from the press reports, that this rigid rule was violated to the extent of having the Secretary of the Association read a list of recent achievements of the contracting fraternity. Also, according to the newspapers, the Secretary's report contained the statement that "the great Panama Canal work was costing two and one-half times as much as the bid of Oliver & Bangs, and that the government was wasting enough to make ten contractors wealthy."

Some allowances must be made, of course, for post-prandial enthusiasm, and patting one's associates on the back is always a pleasant duty; but such enthusiasm and mutual admiration should not be exposed to the bright light of publicity. Probably the assembled contractors appreciated their Secretary's hyperbole; but the general public fails to take into account the circumstances of the occasion. Thus we read, as a heading to one press account of the dinner, "Losing on Panama Canal—Secretary of Contractors' Association Compares Cost to Private Bid"—which carries the very obvious imputation that the government work at Panama, like much government work elsewhere, is wildly extravagant.

We need not explain to our readers the fallacy of this assertion. Every engineer knows that the magnitude of the Panama enterprise is far beyond the resources of a private company, and that even had such a company undertaken the work, the requirements of administration are so heavy that the necessary government supervision would practically have amounted to work by government forces. Further, the many changes in design incident to construction would have involved so many extra charges that the contractor's bid would have been but a small part of the amount eventually due him. This knowledge should dispose of the first part of the Secretary's reckless charge. The second part is mere talk; it cannot be proved nor is it believed by reputable engineers or contractors.

We trust that the report of the one speech of the "speechless dinner" has not a wide circulation. The honorable business of contracting needs no such special pleading in its defence.

A Schedule of Fees, and Rebating

The German architects' and engineers' standard code of fees, of which we print a free translation in this issue, has been in practical use for some ten years. It is not a doubtful experiment, but has an established standing. Like any such code, it is not followed in every professional engagement, perhaps not even in the majority, but whenever any doubt or dispute arises the code is available as guide or reference; and claims that a charge is arbitrary and unreasonable are readily avoided when it is shown that the charge was based on the standard code.

There is no similar document in existence in this country, if we except the architects' standard (a very general statement of a fixed percentage charge). Attempts have been made to set up a charging schedule in various special engineering fields, but none have gained currency, and broadly it is true that nothing whatever has been done toward establishing a standard of fees in engineering practice. But that it is perfectly practicable to formulate and introduce such a code is proved by the existence and use of the German code.

Various details of the German code may be studied with profit by engineers of all classes. The general fact will strike a reader at the start that the section dealing with engineering fees is very much less detailed and apparently very much more uncertain in its operation than the section on architectural fees. Nevertheless it contains sufficient detail and a sufficiently satisfactory separation of different classes of work to form a useful guide. It refers, of course, only to ordinary practice, which is the most that can be attempted in a standard code.

It is interesting to learn that one passage of the code has only recently given occasion for a discussion in German architectural circles and recommendation for a change. This is the passage relating to rebates or "discounts" or commissions given by contractors, which states that such rebates or commissions are to be paid over to the owner. Opinions may differ as to whether this clause is in its proper place in a schedule of fees or whether it does not rather be-

long in a code of ethics, or code of professional practice. We believe that both in Europe and in this country rebating or "tipping" is, more or less definitely, involved with the criminal law; needless to say, it is fully condemned by ordinary principles of honesty. It appears, however, that the custom of giving such rebates is by no means uncommon in Germany, and that frequently architects accept these rebates as "honest graft," in spite of the contrary clause in the schedule of fees.

It was recently held, in a full discussion of this particular subject by a meeting of architects at Berlin last October, that the clause relating to commissions or rebates should be eliminated from the code, because it may be taken to imply that such rebates are legitimate so long as they are paid to the owner, whereas the contract prices should always be treated as net prices, not subject to rebates or claims for rebate. The meeting further recommended that all societies of architects and engineers be urged to take a decided stand against rebating, to the extent of urging their members to decline to work with contractors who offer such rebates or make any similar promises or inducements in attempting to secure contracts.

The Creation of an Inland Seaport

The establishment of a new port to compete with old and long established ports in the commerce of the world is much more difficult as a commercial proposition than as an engineering problem, and this is particularly the case where any unavoidable disadvantages involve certain inconveniences for the movement of ships. Engineering skill can create a physical port, but its subsequent development as a commercial port is a difficult and more serious problem. The city of Manchester, England, is an important manufacturing city in itself, and the center of a great manufacturing district, but being some 40 miles from deep water the business and growth of both the city and the district were hampered for many years by conditions of land (or barge canal) transportation of goods between this center and a seaport. The difficulties continued to increase with the development of trade until the once-visionary idea of direct water communication with the sea, available for large ocean vessels, became a practical proposition, and after passing through many vicissitudes was brought to a successful conclusion with the opening of the Manchester Ship Canal in 1894.

The ship canal is often considered as in itself constituting Manchester a seaport, but as a matter of fact there was the additional necessity of providing docks, freight and cargo facilities, railway connections and the thousand-and-one accessories of a great port. And in order to compete with other ports and offer inducements to shipping it was necessary that the equipment and facilities should be complete and comprehensive and planned on a very large scale. All this has been done by dint of pluck and enterprise and liberal financial assistance, backed by the firm belief that the project would prove a commercial success.

Beyond all this, however, was the problem of inducing commerce to make use of this new port, and to establish new trade routes. We need not take the space to discuss the work of commercial promotion, some notes of which are given in another column. That it has been done successfully is indicated by the fact that Manchester, though less than 20 years old as a port, now ranks fourth in the list of seaports of Great Britain, on the basis of total annual valuation of imports and exports. It must be remembered, however, that this rapid growth has been due very largely to the fact that Manchester was a great commercial, manufacturing, railway and distributing center, of world-wide repute, long before it became a port. So that it was no new or unknown city which the port promoters sought to force into the ranks of the leading seaports of the world.

It is easy to see that conditions would have been very different with a canal built to some new or minor trade center, whose commerce was to be created by means of the canal and the new trade routes, instead of offering an already large business to these routes. And in addition to this, the distance of Manchester from the sea is comparatively small, only 40 miles from deep water. Had the canal been of much greater length and had it been intended to create a new commercial center, the success of the enterprise would have been postponed materially, if indeed it ever materialized.

These facts need to be borne in mind in considering the possibilities and probabilities of projects for inland waterways designed to be used by ocean steamers and to become new trade routes. The waterway itself is not sufficient, it needs suitable trade centers, with ship and railway terminals and all their accessories. It needs also an initial commerce which will serve as an inducement to traders and shipping companies. And if the navigation between open water and such terminals (or inland ports) involves much loss of time by vessels (due to lockages or to distance traveled at slow speed), it is easy to see that it may be much cheaper and more economical to bring goods to the ship by rail than to bring the ship to the goods by water. We call attention to this matter for the reason that Manchester has been held up as a proof of the advisability of establishing large inland waterways.

Elsewhere in this issue we publish an article on the engineering and commercial features of the port of Manchester, and also an article on a unique industrial enterprise which has an important relation to the commerce of the city and the port. From these articles it will be seen that the conditions in the case of Manchester were of a special and unique character, and are not applicable to or comparable with those of other inland cities for which "ocean waterway" projects have been advanced.

Some Points about the Federal Government Water Power Policy

There is evidence that insufficient knowledge, and in some cases actual misunderstanding, exists throughout the country in regard to the basis on which water powers on the public lands may now be developed. This condition is particularly undesirable from an engineering viewpoint, and we are glad, therefore, to give space in this journal to a discussion by the Chief Hydrographer of the U. S. Geological Survey. He has plainly summarized elsewhere in this issue the need of governmental supervision of water-power development in the future, and the legal basis of the control assumed, together with a statement of the actual regulations. The discussion is so complete that it is unnecessary to comment on it *in extenso* here. There are, however, two points on which questions will arise in the mind of a thoughtful reader, and which deserve some explanation.

Mr. Leighton, before describing the regulations recently put in force, says:

> It is claimed with good reason that because no easement is granted to any lands and because the permit is revocable at will by the Secretary, it is difficult or impossible to secure investment capital. They have also held with good reason that a permittee is subject to dispossession if it should occur that his water-power structures are located on land that is subsequently included in a mineral entry. These and other conditions render a water-power investment unstable. These difficulties have been appreciated by the Secretary of the Interior quite as keenly as by the water-power projector. In the absence of constructive action by Congress, he has made an attempt to overcome many of the difficulties and to minimize others by the adoption of a code of regulations governing the acquisition of rights of way through the public lands (except National Forests) for water-power purposes.
>
> The Secretary of the Interior has endeavored to overcome, so far as is legally possible, the disadvantage of a revocable permit. His agreement as to a 50-year term is an administrative one, which may have no standing in law, but which, nevertheless, has at its back all the integrity of the Interior Department. So

far as that department is concerned, the guarantee is as morally binding as though it were a matter of statutory provision. Deliberate default of such an agreement by the Department, in the absence of wrongful behavior by the permittee, would be so obviously against public policy as to make the event a practical impossibility.

The question which must arise is, of course, what will happen in the event of a change of administration, particularly when not only a new administration, but a new political party is put in control—a condition which we now face? Expressed in other words, is an important administrative agreement, on which the security of investment depends, either legally or morally binding on successive Secretaries of the Interior?

So far as we have been able to discover, such an agreement made by one Secretary is really regarded as morally binding on his successors. Indeed, by many it is regarded that there exists almost a jurisprudence based on the agreements and precedents in the Department. There is, at Washington, a legal practice before the Secretary (of this or other departments) constituting in itself as important a branch of law as any other in that city.

Moreover, while some future Secretary may radically change the present water-power regulations, we may rely on a long line of departmental precedents that such changes will not be retroactive if imposing more severe burdens. If a water-power permittee under the present regulations has made an investment in good faith and observed the required stipulations, his injury would be decidedly against public policy and the result of a disorderly department—both ideas quite intolerable to public sentiment and leading to the inevitable downfall of an unfair administration.

The second point which deserves comment is the effect of a terminable permit on the rights-of-way which a power permittee may have secured from the government for the transmission of his generated power. It would seem at first as though, should the United States dispose of a tract of land near a power development and traversed by rights-of-way for power-transmission lines, these rights-of-way, while continuing until the permit ends, would themselves end with the termination of the original permit. Then the renewal of a permit would fail to carry with it the easement that previously existed. This is an important point to be settled, for there would seem to be a chance that the investor might see his power plant bottled up, so to speak, and himself at the mercy of neighbors who might hold him up for any sum they pleased as the condition of continuing his transmission line.

Fortunately, this question seems also safely disposed of. The regulations, it is seen, provide that the permittee may parcels to entry, finding that the land was no longer valuable for power-transmission purposes, as by the abandonment of the right-of-way for an old pole line, then the part in question would automatically become a part of the surrounding tract which has been patented, say by some settler.

arrange for the *renewal* of his old permit, in spite of mentioning the issuance of a new permit; and it seems a settled legal principle that a grant extended in term is in effect the original grant with the old conditions and limitations, and not merely a new grant, dating from the expiration of the old one renewed or extended.

Still another safeguard for the investor exists in a fixed departmental practice which we expect it would be judged unreasonable to change: In granting a right-of-way for part of a power development or transmission system, the land involved is reserved from all forms of legal entry. As shown in Mr. Leighton's exposition of the regulations now in force, "any tract traversed by rights-of-way granted under a permit are subject to that right-of-way until the permit shall have expired, or have been revoked." This larger tract traversed by the smaller rights-of-way is not merely "subject to that right-of-way," but the title to strips of land involved in the rights-of-way does not pass from the government.

For instance, take the case of a transmission line passing over a public tract subject to homestead entry. When title to the tract is later given, title to that part involved in the right-of-way does not pass from the federal government; the land remains "withdrawn from entry." Should the permit be revoked or expire, and the department restore the

What Hypochlorite Accomplishes*

By C. A. Jennings†

Bacteria reductions, both total and B. coli, effected by the use of hypochlorite as a disinfecting agent in connection with several city water-supplies are given. The bulk of the paper presents similar data for typhoid fever as related to the public water-supplies of a much larger number of cities. Finally, the true place of hypochlorite in water treatment is briefly stated.

In considering typhoid-fever statistics before and after the introduction of the hypochlorite treatment, it is often very difficult to make a fair comparison for the reason that there is a woeful laxity in reporting these statistics in many cities. This is usually conscientiously looked after following an epidemic, but seldom previous to one. However, the writer has gathered sufficient reliable bacteriological data as well as typhoid-fever statistics to show the effect that sterilization has had on the bacterial content of the water and on the reduction in the number of cases and deaths from typhoid fever.

Bacteriological Data

Terre Haute, Ind., has a pressure-filter plant. The average bacterial count for February, March and April, 1912, was: raw water, 3870 per c.c., with B. coli present in 68% of the samples tested, while the filtered and sterilized water showed only 34 per c.c., with B. coli absent in every sample tested. Samples were collected daily.

Cedar Rapids, Iowa, began using hypochlorite in March, 1912, as an adjunct to its rapid sand filters and the results have been spectacular. During the period from Mar. 29 to May 15, 1912, the raw water averaged 40,200 bacteria per c.c.; filtration alone showed a reduction in bacteria of 1700 per c.c., or 95.8%, while the hypochlorite-treated water count was only 44 per c.c., or a total reduction of 99.9%. B. coli was present in 63% of the raw-water samples examined, in 36% of the filtered-water samples, but not a single 1 c.c. portion of the sterilized water showed B. coli.

Montreal, Que., draws its water-supply from the St. Lawrence River and sterilizes it with hypochlorite. The untreated water averages 800 bacteria per c.c., with B. coli present in 98% of the 10-c.c. portions and in 45% of the 1-c.c. portions tested. The treated water averages 25 bacteria per c.c., with B. coli absent in both 10-c.c. and 1-c.c. portions tested.

Grant's Pass, Ore., has, as its source of supply, Rogue River, a clear mountain stream. However, there are several sources of pollution by sewage from cities above. The hypochlorite treatment reduces the bacteria from an average of

†Consulting engineer, Union Stock Yards, Chicago, Ill.

*From a paper read before the International Congress of Applied Chemistry in New York City, September, 1912. The historical introduction, a few general cost figures and diagrams corresponding with or enlarging on the typhoid and and on some of the bacterial data have been omitted.

600 to 15 per c.c. Since the hypochlorite process was begun Sept. 16, 1911, and up to June 1, 1912, there were but two cases and no deaths from typhoid fever reported in this city of 5000 inhabitants.

BAUDETTE, MINN., had a typhoid-fever epidemic in the fall of 1910 and began immediately to sterilize the water-supply. No specific data are available, but the following quotation from a letter from the town clerk is significant: "It has been our experience that the hypochlorite plant is a very valuable asset. Previous to installing the hypochlorite plant typhoid fever was very common. Since that time (to May 30, 1912) no typhoid fever has been called to our attention. We, therefore, believe that the hypochlorite plant has been a very satisfactory preventative of this class of disease."

NASHVILLE, TENN., after drawing the water from the Cumberland River, coagulates it with alum and allows it to settle in large basins. It is then sterilized with hypochlorite of lime. The average bacterial content of the raw water is 3000 per c.c., with 90% of the 1-c.c. portions tested showing B. coli present. The settled and sterilized water shows an average of only 70 bacteria per c.c., and during the year 1910 only three samples out of 1200 tested showed B. coli present.

DANVILLE, ILL.—Although Danville has been using the hypochlorite treatment as an adjunct to its rapid sand-filter plant for only a very short time (since February, 1912), nevertheless the bacterial data on the filtered water are very interesting. During the time that hypochlorite was used, the average bacterial content of the sterilized filtered water was only 57 per c.c. During the period from Mar. 20-25, inclusive, the supply of hypochlorite was exhausted and so none was used. The bacterial content of the untreated filtered water during this period was 4100 per c.c. With hypochlorite treatment in use Mar. 19, the count was but 20 per c.c.; on Mar. 20, without hypochlorite, the count jumped up to 8400 per c.c. The removal by filtration without hypochlorite, from the raw water averaging 67,000 bacteria per c.c., was 93.9%; by filtration and hypochlorite from the raw water averaging 52,496 bacteria per c.c., the removal was 99.89%. Without sterilization, B. coli was present in the filtered water on five of the six days; with sterilization, B. coli was present on one day out of 34. The turbidity of the raw water was so low from May 26 to June 1, 1912, that no coagulant was used and only hypochlorite added to the filtered water. The average reduction in bacteria during this period was 99.6%.

TYPHOID STATISTICS

A comparison of typhoid-fever statistics before and after the introduction of hypochlorite is very interesting.

NORTH YAKIMA, WASH.—In 1910 there was a typhoid epidemic caused by a contamination of the domestic supply through a cross-connection with a highly polluted fire service. During the period September, 1911, to June, 1912, there was not a single death from typhoid fever and only one case was reported between Dec. 22, 1911, and June 1, 1912. The water sterilization began July 9, 1911. The source of supply is a mountain stream which is open to contamination. The reduction in the number of cases and deaths from typhoid fever is due in part to the general clean-up and condemnation of many polluted shallow wells as well as to the hypochlorite treatment in this booming city of the Northwest.

COUNCIL BLUFFS, IOWA—The wonderful efficiency of hypochlorite is shown by a typhoid-fever epidemic in Council Bluffs, Iowa, which began in the fall of 1909 and ended with the introduction of hypochlorite in April, 1910. Since this treatment was inaugurated, a period of 25 months to June 1, 1912, there have been but five deaths from typhoid fever in this city with a population of 30,000 and one of these five deaths was that of an imported case. This is a remarkable record. For the eight months following the introduction of hypochlorite there was not a single death from typhoid fever.

CLEVELAND, OHIO, draws its water-supply from Lake Erie, which is polluted in part by its own sewage and in part by neighboring cities. After typhoid fever had been prevalent to a great degree in this city for years a remarkable reduction in the number of cases and deaths from this disease followed the beginning of the treatment with hypochlorite in September, 1911. There was 159 cases and 19 deaths reported for that month. For the eight months, Oct. 1, 1911, to June 1, 1912, there were totals of 180 cases and 28 deaths reported. During similar periods in previous years the figures are:

	Cases	Deaths
Oct. 1, 1907 to June 1, 1908	290	46
Oct. 1, 1908 to June 1, 1909	311	52
Oct. 1, 1909 to June 1, 1910	343	66
Oct. 1, 1910 to June 1, 1911	347	65
Average 1907-1911	323	57

These figures compared with 180 and 28 cases and deaths, respectively, for 1911 to 1912 show reductions of 44% in the number of cases and 50.8% in the number of deaths. This represents an average of 29 fewer deaths in eight months, while hypochlorite was being used compared with the period before the water was treated. Taking the figure of $5000 as the value of each life sacrificed to typhoid fever, the financial saving effected by hypochlorite in eight months has been $145,000, which amount capitalized at 5% represents the tremendous sum of $2,900,000.

ERIE, PENN.—Although it is acknowledged that the typhoid epidemic at Erie was water borne, nevertheless the exact point of introduction of the contamination has not been definitely determined. The water-supply is taken from Lake Erie and, previous to Mar. 15, 1911, was not treated with hypochlorite. December 1910, with 31 cases and 2 deaths was followed by January, 1911, with 239 cases and 24 deaths. The Pennsylvania State Board of Health began treating the water-supply with copper sulphate Jan. 28, 1911, and this was continued until the hypochlorite was substituted. The latter process has been in use without cessation since Mar. 15, 1911. The number of cases and deaiths from typhoid fever during the twelve months from June 1 to May 31, during the past four years, is as follows:

1908–1909		1909–1910		1910–1911		1911–1912	
Cases	Deaths	Cases	Deaths	Cases	Deaths	Cases	Deaths
153	16	202	29	1140	136	91	11

Thus it will be seen what a good record the hypochlorite treatment has made at Erie in the reduction of typhoid fever. The average number of cases and deaths for the three years 1908-1911 was 498 and 60 compared with 91 cases and 11 deaths since hypochlorite has been used. The value of 49 lives saved from typhoid fever at $5000 each, is $245,000, which, capitalized at 5%, amounts to a total of $4,900,000. The raw water averaged 674 bacteria per c.c., with B. coli present in 11% of the samples tested, while the treated water averaged only 49 bacteria per c.c., with B. coli present in only 1 sample out of 1025 examined—less than 0.1%.

TORONTO, ONT.—During the first two months of 1910 there were 723% more cases and 450% more deaths from typhoid than the average for the same two months during the five years previous. Hypochlorite treatment was begun in March, 1910, and an immediate reduction in the number of cases and deaths was effected. The cause for a rise of cases to 90 for two consecutive months in 1911 is explained in a quotation from a letter from Dr. Geo. C. Nasmith, Director of Municipal Laboratories:

> I may say that last year our intake plugged with sand and we were forced to short-circuit our water-supply and take it from the Bay into which all our sewage empties. We had the makings of the largest typhoid epidemic ever known on this continent, but fortunately we had hypochlorite to depend on and we came through with a typhoid death rate of 20 per 100,000 in 1911, as compared with 45 per 100,000 in 1910, which, you will agree, was an extremely satisfactory showing.

The first four months of 1912 show 64% fewer cases reported than the same period in 1911 and 65% fewer cases than the average for the same periods 1905 to 1910 inclusive and 50% fewer deaths.

BALTIMORE, MD., drawing its water-supply from two impounding reservoirs, began to sterilize the water with hypochlorite on June 6, 1911, to keep down the annual autumn typhoid-fever epidemic.

Since then both cases and deaths have been lower than before the use of hypochlorite. For the period June 1, 1910, to May 31, 1911, there were 1964 cases and 233 deaths from typhoid fever, while from June 1, 1911, to May 31, 1912, while using hypochlorite, there were 1155 cases and 160 deaths, reductions of 41% and 31%, respectively. Hypochlorite treatment presumably saved 73 lives in one year. These valued at $5000 each, amount to $365,000, which totals the enormous sum of $7,300,000 when capitalized at 5%. This is a wonderful saving to a community of 564,000 people in twelve months.

EVANSTON, ILL.—During the past winter Evanston, Ill., had a typhoid epidemic, traceable to the water-supply, contaminated by the sewage of the city itself. Although the use of hypochlorite was not begun until Dec. 19, 1911, nevertheless there was a reduction from 49 cases reported in December, 1911, to 12 cases in January, 1912, which dropped still further to nine cases in February, showing how thoroughly the hypochlorite treatment did its work. The untreated lake water, averaging 5000 bacteria per c.c., with B. coli present, was reduced to an average of 75 per c.c., with B. coli shown to be absent in all 1-c.c. portions tested.

WAUKEGAN, ILL.—Conditions as to the pollution of the water-supply of this city with the city's own sewage are identical with those of Evanston. The increase in typhoid-fever cases reported, however, occurred later than in Evanston. A total of 82 cases in March was reduced to 56 in April and 27 in May, hypochlorite having been used for the first time on Apr. 16, 1912.

MINNEAPOLIS, MINN.—There was an abnormal amount of typhoid fever in 1909 and 1910. The water-supply was taken from the Mississippi River without any treatment. The use of hypochlorite was begun late in 1910 and has been continued without interruption since that time. A modern filter plant of the rapid sand type is now being constructed, but the hypochlorite process will be used in conjunction with it when completed. The water is reduced from an average of 816 bacteria per c.c. to 5 per c.c. The 39 typhoid deaths in the ten months before hypochlorite and the two deaths in the ten months after hypochlorite was used, or a reduction of 95%, is remarkable.

OMAHA, NEB.—Hypochlorite has been used since May, 1910, at which time there was an epidemic of typhoid in the city. The Omaha typhoid fever death rates per 100,000 for the last four years have been:

1908	1909	1910	1911
16	26	67	13

A reduction from 67 to 13 per 100,000 is remarkable and it is difficult to say how much higher the rate would have been in 1910 had not the sterilizing process been installed in May of that year. It is worthy of mention that the treated and settled water shows an average of only 43 bacteria per c.c., whereas the raw water from the Missouri River averages 30,447 per c.c.

JERSEY CITY, N. J., was one of the first cities to adopt hypochlorite treatment for municipal water-supplies. The water from the storage reservoir averages 12,000 bacteria per c.c., with B. coli present, but the treated water averages only 10 per c.c., with B. coli absent. Hypochlorite treatment was begun in September, 1908. The average for 1905, 1906 and 1907 was 18.5 per 100,000 and this was reduced to an average of 9.6 per 100,000 for the three years following the use of hypochlorite, namely, 1909, 1910 and 1911, a reduction of 48% in the average typhoid fever death rate.

KANSAS CITY, MO., takes its water-supply from the muddy and polluted Missouri River and by means of sedimentation and sterilization reduces the bacterial content from an average of 5500 per c.c. to 65 per c.c. The raw water shows B. coli present in 0.2 c.c., whereas this sewage organism is absent in all 1-c.c. portions of the treated water tested. The number of typhoid deaths reported during 1910 without sterilization of the water was 107, while for 1911, with hypochlorite treatment in use, it was 61, a reduction of 43%. Many people in Kansas City use the clear and sparkling waters that issue in many places from springs and which can be pumped from surface wells. These waters have been shown to be very highly contaminated, although they are of very attractive appearance. The city is now conducting a campaign to discontinue the use of these waters for drinking.

CINCINNATI, OHIO, has a rapid sand-filter plant with a capacity of 112,000,000 gal. per day. The hypochlorite treatment has been used as an adjunct to the filtration process since December, 1910, with a reduction from an average of 315 to 26 per c.c., or 91.7% reduction in the filtered water itself. B. coli was present in 0.6% of the 1-c.c. samples and in 91.1% of the 100-c.c. samples of filtered water examined, but in the treated filtered water tested no 1-c.c. portions showed B. coli present and only 12% of the 100-c.c. portions were positive.

CONCLUSION

These data show conclusively that the hypochlorite of lime treatment of water-supplies is wonderfully effective; that it reduces the bacterial content of water to a very low number; that it practically eliminates B. coli and, therefore, we think, B. typhosus, from water-supplies; that it is a very valuable adjunct to filter plants; that mountain streams and impounded reservoir supplies are made safe by its use; that it has stopped many typhoid-fever epidemics already begun and in all probability it has prevented many epidemics from occurring. Hypochlorite is not a panacea for all troubles arising from water-supplies, but when properly applied to the proper water in the correct quantities, it will accomplish wonderful results. Its great cheapness as to installation and operation, the short time necessary to install the treatment and its comparative simplicity, will surely cause disinfection by hypochlorite of lime to be continued and to be adopted by other cities where the supply is not all that it should be.

Annual Meeting of the American Society of Mechanical Engineers

The thirty-third annual meeting of the above society was held last week in New York City. The most notable features of the meeting were a radical change in the social affairs connected with the meeting and, in connection with the technical sessions, a further development of the plan of holding special sessions devoted to different branches of engineering work.

At every previous annual meeting for many years a subscription fund has been raised by the members of the society resident in New York City and vicinity, amounting to $2000 to $3000. That money has been expended in paying for the entertainment in connection with the President's reception, which forms the opening function of the annual meeting on Tuesday evening, for the free lunches served at the noon hour on Wednesday and Thursday, and for the conversazione and ball held on Thursday evening, in former years at Sherry's and in recent years at the Hotel Astor.

As the result of much criticism and discussion, the plan of collecting a subscription fund from the New York members was this year for the first time abandoned, and the policy was adopted of having each member pay his own way. The collation and other expenses in connection with the president's reception on Tuesday evening were paid for from the society's general fund. The noon luncheons on Wednesday and Thursday were paid for through the purchase of tickets by those participating, and the annual ball at the Astor was abandoned.

While such radical changes naturally aroused more or less criticism, the great majority of the members, apparently, were better satisfied with the policy of paying themselves for what they enjoyed than in free entertainment purchased perhaps at the cost of unwilling subscriptions by some of the local members.

Certainly it cannot be said that the annual meeting of 1912 was lacking in sociability and entertainment. The Presi-

dent's reception on Tuesday evening, which in earlier years was an informal and usually a thinly attended gathering, has now become the most important social function of the whole meeting. This is as it should be, since it is the occasion of the annual address of the retiring president and of the formal introduction of the newly elected President to the members of the society.

What is of more importance still from the social point of view, is that it gives the best opportunity of the whole session for the general renewal of acquaintanceship among the members who may not have previously met for months or years.

The second notable social feature of the convention—indeed, it may be called its social climax—was the subscription dinner given on Wednesday evening in honor of Prof. John E. Sweet, of Syracuse, N. Y. The dinner was given in celebration of Prof. Sweet's eightieth birthday, and to quote from the menu card, "in recognition of his services to the engineering profession." It might have been added, "to the American Society of Mechanical Engineers," for it is to Prof. Sweet, as much as to any one man, that the Society owes its creation.

While this dinner was not nominally a society event, it was open to all members of the Society; and practically all of the 300 or more guests who sat down to the banquet were members of the Society —or the better halves of members. The dinner was served in the Engineering Societies' Building; and it is noteworthy that this is the first formal dinner that has ever been served in the building since its opening. Ambrose Swasey, of Cleveland, a life-long friend of Prof. Sweet's, acted as toastmaster, and the other speakers were Dr. Humphreys, the retiring president of the Society; R. W. Hunt, past-president of the Society; Prof. Albert W. Smith, director of the Cornell Engineering School, of which Prof. Sweet was the founder and first professor, and Dr. John A. Brashear, honorary member of the Society.

On Thursday evening there occurred another social event, which, again, while not strictly a function of the American Society of Mechanical Engineers alone, was actually an important event of the week and one in which practically all the members attending the meeting took part. This was the conferring upon Robert W. Hunt of the John Fritz medal in recognition of his contribution to the early development of the bessemer process of steel making.

The exercises in connection with the bestowal of the award and the reception which followed these exercises was a joint function participated in not only by the American Society of Mechanical Engineers, but the American Institute of Mining Engineers, the American Institute of Electrical Engineers, and the American Society of Civil Engineers.

Mention should also be made of the usual attractive program of excursions, which were provided by the local committee for the entertainment of visiting members.

The newly elected officers of the society, chosen as a result of a letter ballot and announced at the meeting, are as follows: President, W. F. M. Goss, Dean of the Engineering School of the University of Illinois; Vice-Presidents, James Hartness, Springfield, Vt.; L. E. Moultrop, Boston, Mass.; Henry G. Stott, New York City. The new Managers elected are: Messrs. Wm. B. Jackson, of Chicago; H. M. Leland, of Detroit, and Alfred Noble, of New York City.

Turning now to the technical sessions of the meeting, which were held both morning and afternoon on Wednesday, Thursday and Friday, it may be said at once that it would be hopeless within the brief limits of space here available to give even a brief abstract of the long series of papers and discussions. What is well worthy of note here is that the current meeting marks a distinct advance in the development of the society, a recognition of the fact that mechanical engineering is no longer a branch of the engineering profession, but has itself specialized into a dozen or twenty or fifty branches.

Twenty-five years ago the papers and discussions before the society were largely concentrated on the single topic of steam-power engineering. The society could then meet as a single body and hold the interest of its members in discussion on this single subject. At present, the society is no more than keeping pace with the changes in the field of engineering work by specializing into sections devoted to different fields of operation.

For example, on Wednesday morning there were simultaneous sessions of three different sections of the society, one devoted to power plants, one devoted to engineering work in connection with textile manufacture, and one devoted to gas power. Similarly on Thursday morning there was a general session in charge of the sub-committees of the society on machine-shop practice, and iron and steel. There was simultaneously a railroad session, at which papers on car lighting and the selection of locomotive types were read and discussed, and a session on engineering work in connection with cement plant operation.

A further notable feature of the convention was the session on Friday, which was devoted to the subject of scientific management and efficiency engineering. The basis of this session's work was the report of the sub-committee of the society upon this special subject, which summarized the state of the art, so to speak, with relation to the subject of scientific management. There were no less than 40 members of the society who had either signified their intention to discuss this report when presented or had sent in written discussions thereof.

This proved to be in fact the most largely attended and active technical session of the whole meeting. The morning session was not long enough to complete the list of those who desired to be heard in the discussion, and adjournment was taken until the afternoon hour. Attendance both morning and afternoon was the largest at any session held during the meeting, a good evidence of the amount of attention which the subject now claims at the hands of the engineering profession.

The spring meeting of the society is to be held in Baltimore during the month of May, with headquarters at the Hotel Belvidere. An attractive program is already in preparation for this meeting. In the following month comes the excursion of the society to Germany to hold a joint meeting with the Verein Deutscher Ingenieur. Members of the society will sail on June 10 on the Hamburg-American Steamship "Victoria-Luise," arriving at Hamburg on June 21.

While there are ample quarters available on this great steamer for all the members of the society who may wish to take the European trip at that time, the accommodations available in the German cities which will be visited on the tour make it necessary to limit the number of the official party to 200 members and 100 ladies as the maximum. As many members have already registered their intention to take part in this meeting and have secured passage on the steamer, prompt action will be necessary on the part of others who desire to be included in the official party.

Scientifically Planned Municipal Forestry operations are being carried on for the city of Syracuse, N. Y., by the College of Forestry of Syracuse University. The water department of Syracuse has put in the hands of the College of Forestry 150 acres of wooded land on the drainage area of the city water-supply. This land is located on an abrupt slope at the south end of Skaneateles Lake. It is covered with second growth. During the summer of 1912 five forestry students under the direction of an instructor made a topographical survey and map of the tract and laid out and built fire lines along two sides. Plots, ranging from an eighth of an acre to an acre in size, have been selected for treatment in accordance with various forestry plans. These plans include thinning to various degrees and underplanting with evergreens, which latter will be done in the spring of 1913. Improvement cuttings are being carried out on the remaining and larger portion of the tract. Some planting will also be done in 1913 in the more open portions of the area. Measurements will be made from time to time to determine the increment or additional growth of the trees now standing on the land. Careful estimates showed that in 1912 the 150 acres had upon them 600,000 board feet of standing timber.

The American Road Builder's Association Convention

This association held its ninth annual convention in Cincinnati, Dec. 3 to 6. Seven sessions were held, two daily, except the last day, and the average attendance was close to 500. An exhibition of road-building materials, equipment and machinery was held in connection with the convention.

At the opening session the President, Nelson P. Lewis, Chief Engineer of the Board of Estimate and Apportionment, City of New York, gave an address in which he emphasized the dangers in present methods of "good-road" financing. An abstract of the address was printed in our last issue.

HIGHWAY DEPARTMENT ORGANIZATIONS—This subject was treated in three papers as follows: (1) For a state, by W. W. Crosby, Consulting Engineer of the Maryland State Roads Commission; (2) For a large city, by William H. Connell, Chief of the Bureau of Highways and Street Cleaning, Philadelphia, Penn.; (3) For the town and county, by A. N. Johnson, State Highway Engineer of Illinois.

Maj. Crosby favored a small commission. Under any kind of a commission the Chief Engineer should be the executive head of the department. The keynote of success in any engineering organization he found to be a proper understanding of the extent and the limitations of the responsibility of every member. He recommended a separate department under an assistant engineer to have entire charge of the maintenance of existing roads, a part of a highway organization often neglected.

Mr. Connell stated the prime requisite of an efficient city highway department was to have it in charge of an engineer of experience; the full control of the streets should be centralized in the highway department, and all pavement openings for gas, water, sewers, electric wire conduits, etc., should be under the supervision and control of the highway bureau's engineers. He was strongly in favor of city day labor for pavement repairs and maintenance, and he recommended the keeping of careful cost data, not primarily for the cost element, but because it furnished a means by which the strong and the weak points of an organization were brought out, and it impressed the foremen with a sense of responsibility and gave them a greater interest in their work.

Mr. Johnson gave an interesting account of the manner in which county road work was now handled in Illinois, where there are no less than 4800 highway commissioners of various grades. Of the $7,000,000 recently expended he estimated at least half was wasted by inefficient management and the superfluity of officials.

In discussing these papers, M. Jean de Pulligny, Chief Engineer of Bridges and Roads of the French Government Service, explained in some detail the French systems of national and local highway organizations, noting particularly the great attention paid to maintenance. Col. E. A. Stevens, State Commissioner of Public Roads of New Jersey, thought a part of the burden of maintenance of all roads should be shared by the state in the case of the poorer communities. A. R. Hirst, State Highway Engineer of Wisconsin, said that the coöperation of the state and any town which would contribute half the expense had resulted in the building of a great many short stretches of improved road, and that this system was eminently successful in arousing small communities to better their roads. In Wisconsin, state aid is given for the construction of earth and gravel roads as well as macadam.

BITUMINOUS PAVEMENTS—The sessions on Dec. 4 were presided over by Harold Parker, of Worcester, Mass., former President and now Vice-President of the association. The first paper read was by George W. Tillson, Consulting Engineer of the Borough of Brooklyn, New York City, on "Bituminous Pavements for City Streets." The paper dealt thoroughly with the materials and the most approved methods of construction and maintenance. Regarding the life of an asphalt pavement, Mr. Tillson referred to the article in our issue of Sept. 26, 1912, by George H. Norton, Deputy Engineer-Commissioner of Buffalo, N. Y., as "the most valuable information on this subject that has ever been presented to the public." He stated that asphalt was by far the most popular pavement among property owners.

In discussing Mr. Tillson's paper, R. K. Compton, Chairman of the Paving Commission of Baltimore, Md., gave some interesting experience with asphalt in that city as compared with Mr. Tillson's experience in New York. L. K. Rourke, Commissioner of Public Works of Boston, Mass., said that asphalt pavements in the downtown streets of Boston were unsatisfactory because of the narrowness of the streets and the density of traffic.

CREOSOTED WOOD BLOCK—A paper was presented on creosoted wood-block pavements laid by city day labor in Minneapolis, Minn., by E. R. Dutton, Assistant City Engineer.

CUTS IN PAVEMENTS—A paper was read on "Cuts in Newly Paved Streets," by J. E. Barlow, Assistant City Engineer of Cincinnati. He explained the subsurface survey now in progress in Cincinnati to determine the locations of all underground pipes and conduits; and emphasized the need of giving public service corporations ample warning of intended street improvements, so that all openings might be made before the pavement was laid.

DEVELOPING A STATE ROAD SYSTEM—A paper presented by James R. Marker, State Highway Commissioner of Ohio, on "The Development of a Plan for a State Road System," dealt with the principles and influences involved in selecting roads for expending state funds on road improvement.

CONTRACTORS VS. ENGINEERS—The most animated discussion of the convention was precipitated by a paper by Hugh Murphy, a road contractor of Omaha, Neb., entitled "The Contractor's Point of View." Mr. Murphy thought material manufacturers exerted too great an influence on bituminous-pavement specifications, and found much cause for complaint in the "patent methods" clause commonly found in specifications. He read a number of actual specification clauses as examples and stated in forceful and humorous terms the many disadvantages under which contractors labor.

John R. Rablin, Chief Engineer of the Metropolitan Park Commission, of Boston, Mass., came to the rescue of the engineers by stating that the objectionable clauses in specifications were often there to protect the public from irresponsible bidders. L. K. Rourke thought specifications should be written in the simplest possible terms and be used as a guide only; the engineer should be an arbitrator, not a dictator. The long and active discussion was terminated by President Lewis, who stated that the reason why contractors had so little trouble with private corporations and so much difficulty in public work was because engineers on public work do not have the same freedom; specifications were not so much the whim of the engineer as a protection to the taxpayers; limitations were imposed on the spending of public money over which the engineer had no control.

ROAD CONTRACTOR'S EQUIPMENT—F. E. Ellis, Manager of the Essex Trap Rock & Construction Co., Peabody, Mass., read a paper describing in detail the equipment necessary for a modern road builder, and giving many suggestions useful to a contractor in selecting machinery.

MACADAM ROADS—The sessions on Dec. 6 opened with a paper by T. R. Agg, Road Engineer, Illinois State Highway Commission, on the construction of macadam roads. Mr. Agg said that the best practice in building waterbound macadam roads was often disregarded. In the discussion, John S. Gillespie, Road Commissioner of Allegheny County, of Pittsburgh, Penn., declared that macadam roads were no longer of any use; but the general opinion was against this extreme view.

EARTH AND GRAVEL ROADS—This paper by R. C. Terrell, Commissioner of Public Roads of Kentucky, related almost wholly to methods employed in that state.

BRIDGES AND CULVERTS—W. A. McLean, Provincial Engineer of Highways of Ontario, said that as bridges and culverts properly built would be permanent structures, they might well be paid for with long-term bonds. A. W. Dean, Chief Engineer of the Massachusetts Highway Commission, said that concrete piers and abutments in salt water had proved unsatisfactory; that the concrete invariably disintegrated between tide levels, and stone was preferable. He advocated preservation of wooden bridge floors by sprinkling with tar.

ECONOMICS OF ROAD CONSTRUCTION—A paper by Clifford Richardson, of New York City, on this subject further elaborated the views expressed in President Lewis' opening address that the economic side of road improvement was too frequently disregarded. He said the burden of construction and maintenance did not now fall chiefly upon those whose motor vehicles were the cause of the rapid destruction of road surfaces. He suggested a small tax on gasoline, the revenue to be devoted to road maintenance.

C. Gordon Reel, State Superintendent of Highways of New York, defended that state's $100,000,000 issue of 50-year bonds for road construction. He contended that the grading, improved alignment, foundation and other features representing at least 50% of the construction work could be considered permanent. He considered a tax on gasoline a good idea, and would suggest its consideration at the next session of the New York legislature.

TRAFFIC CENSUS—William D. Sohier, Chairman of the Massachusetts Highway Commission, described the methods of taking a traffic census in that state and the uses of the data obtained.

RAPID PAVING WORK—In a paper entitled "The Laying of 104 Miles of Smooth Road Surface in One Borough in Five Months," G. Howland Leavitt described in detail how the Borough of Queens, New York City, of which he is Superintendent of Highways, spent $1,800,000 in five months on pavements of various kinds. The work was all done by contract and Mr. Leavitt described the methods and the plants used by the contractors.

FEDERAL AID—B. F. Tait, Highway Commissioner of Wyoming, spoke in favor of federal aid for highways in the sparsely settled parts of the West. Other speakers from the West suggested that the federal government might give certain tracts of public land to the state, which could be bonded to raise funds for highways. Mr. Meeker, of New Jersey, thought the same arguments which brought about state aid applied with equal force to federal aid. President Lewis said that every highway should be treated as becoming ultimately a part of an interstate system; but he thought that the locality benefited should bear a larger share of the expense than the general public.

At the regular business session a resolution was adopted declaring that the association unqualifiedly supported the appointment of a committee by the President of the United States, consisting of experts in the construction and maintenance of highways and the relative material requirements of different sections of the United States, to investigate and report upon the advisability of establishing a system of national highways.

Pollution of Water in the Mains at Chicago*

In December, 1910, we received a complaint from a resident of Rogers Park that the city water drawn from plumbing fixtures had an odor like manure. The plumbing inspector in that district was instructed to investigate, and he found a greenhouse in the neighborhood which had a cistern pump connected to the city service pipe. Leading into this cistern there was a manure-tank drip. The manure tank was not only used for the purpose of treating manure, but was used as a privy vault. The liquids were permitted to drip into the cistern and in turn it was pumped into the hose connections for spraying and fertilizing plants. In order to get sufficient force to destroy insects, such as the red spider, it is necessary to spray with a force of about 60 lb., which was obtained by the house pump on the premises.

As this spray was not always used for watering the plants, the city water was used through the cross-connection with the city service pipe. The city pressure was usually left on to the hose connections. Whenever the cistern pumps were started, it is supposed that it was the intention to have the city service cross-connection shut off. But as this was not done, the greater pressure from the house pump would force the cistern manure water out into the city main. Upon finding this condition we hastily organized a crew of inspectors to inspect all greenhouses for like connections. The results showed 24 greenhouses with manure tanks and cisterns with cross-connections with city service pipes, ranging in size from ¾-in. to 2-in. pipes. We notified the owners to separate the city supply from the cistern connections, and followed up such notices until we had such connections discontinued.

Continuing this line of investigation, we inspected the factories along the Chicago River for river connections. We found 48 factories with cross-connections from river pipes and pumps to city service pipes, most of them ranging from 2 in. to 6 in. diameter. The pumps on the river connections in all cases generated a greater pressure than was maintained on the city mains. The danger of contaminating the city water in the mains is manifest. We had at least one case where it was positive that a factory was forcing the river water into the city main. Our men in making a repair to a broken main in the river district were unable to stop the flow of water. On account of its being dirty water the matter was referred for inspection, which revealed a river connection in a neighboring tannery, with the cross-connection open to house pump, so that whenever the pump was started it forced river water into the city mains.

We have had all such connections changed, compelling the use of separate pipes for river water. We hurried this work and permitted no cross-connections of any kind. Some of the owners requested permission to use cross-connections and check valves. This was positively prohibited, as it is well known that a check valve seldom remains tight for any length of time.

We further made an inspection for cistern connections along the Chicago River, as some of the factories pumped from cisterns or sumps close to the river. We found four packing houses and three factories on the Calumet River with cross-connections from cistern pumps to city service pipes. The cisterns in all cases were foul; the water very bad.

An ordinance should be prepared making it a punishable offense for anyone to make or maintain any cross-connection or pump connection from the Chicago River, the Calumet River, or any tank, cistern, sump, etc., to the city water supply. It should provide that all users of such waters must maintain a separate piping system. A careful investigation should be made from time to time of such factories, and a record kept at the Water Office of all such consumers and the purpose of use of such waters.

*From the report of H. L. Lucas, Superintendent of Water Pipe Extension, published in the annual report of the Department of Public Works, Chicago, for the year 1911.

A Cyclone in the Island of Madagascar, on Nov. 26, is reported to have cost 100 lives and destroyed property worth $2,000,000. All communication with the rest of the world was cut off, for a time following the storm.

An Explosion of Firedamp in a coal mine at Alais, France, on Nov. 24, caused the death of 24 miners of the 38 who were in the mine at the time of the accident. The 14 who escaped were warned by the action of their safety lamps that explosive gas was present.

A Broken Journal on the rear truck of a tender caused the derailment of a New York Central passenger train near Schenectady, N. Y., on Dec. 1. It is believed that the journal failure did not cause an immediate derailment, but that the train traveled some distance past

the point where the failure occurred, being finally forced from the rails when the disabled truck passed a switch. Eight of the nine cars of the train were ditched but not one of the 200 passengers was seriously injured.

In a Rear-end Collision on a Pennsylvania R.R. line, near Dresden, Ohio, on Dec. 3, 11 persons were killed and four others were badly injured. A Cincinnati & Muskingum Valley passenger train was closely following another passenger train of the Cleveland, Akron & Columbus division, when a plug blew out in the locomotive of the latter, causing it to be temporarily stalled. A flagman was sent back immediately to stop the other train which was known to be close behind, but there was too little time to enable the engineer of this second train to stop. His locomotive struck the rear car of the stalled train and telescoped it, crushing some of the passengers and scalding others.

An Elevated-railway Collision under dangerous circumstances caused a number of injuries, but no deaths, in New York City on Dec. 6. A southbound train leaving the 110th St. station of the West Side line of the Interborough Rapid Transit Co. elevated-railway system rounded the sharp curve into Columbus Ave. and just beyond the curve ran into the rear of a preceding train, which in turn had stopped because the track ahead was occupied. The elevated structure at this point is very high, and derailment would have been particularly serious. The curve is at the north end of a sharp down-grade, which has long been recognized to be a threatening condition; the present accident occurred in a southbound movement, however. This elevated railway system is, in general, not signaled, except for warning signals at curves. The motorman of the colliding train had no block signal to guide him when he started out of 110th St. station (just at the north entrance to the curve) and his view of the track was blocked by a northbound train.

The Bridge & Train Accident at Glen Loch, Penn., on the Pennsylvania R.R., noted in our last issue, has been reported upon by J. P. Dohoney, Marshal of the Pennsylvania State Railroad Commission. The substance of his report is given below. The accident occurred at 11:39 p.m., Nov. 27, 1912, at a bridge crossing the Trenton branch tracks east of Glen Loch. The train weighed 2,313,300 lb.; each of the two locomotives weighed 315,600 lb., and each of the nine sleepers (out of 12 cars) weighed 146,000 lb. It was running at 50 mi. per hr. A few minutes before, a freight train weighing 1352 tons, hauled by two engines aggregating 803,800 lb., passed over the bridge safely. Mr. Dohoney's report says, as to causes of the wreck:

The cause of the derailment was the breaking of a column cap or plate on which the bridge girders found their support. The investigation disclosed no evidence of a broken rail; the wreck did not occur at a crossover; there is but a 2° curve at the point of derailment; there was no disobedience of orders as to speed and no disregard of signals; the engines and other train equipment were in good order.

The bridge is a half-through plate-girder structure 166.3 ft. long. The foundation for its middle support is a pier of masonry about 6 ft. high, on which rest iron latticed columns that extend about 15 ft. high and receive the weight of the girders, cross-beams, etc., on which the tracks are laid.

The plate which failed was fastened to the top of one of these columns and on it rested the end of a box girder. The plate was made of rolled iron, 24 in. square and about ⅞ in. thick, and had been in use since 1892, when the bridge was built. When the plate failed the girder failed with it. In consequence thereof the track sagged about 15 in., and the entire train with the exception of two rear Pullman cars was derailed.

Physical and chemical tests show that the plate had been fractured before the weight of the ill-fated passenger train brought about its final rupture. William N. Ramsey testified before the Coroner's jury that he had inspected the bridge on Nov. 18 and 26, but had found no unsafe condition. The location of the break is practically hidden by the girders and angle bars, and it would have required an inspection of a searching character to have discovered the fracture.

A committee of the Pennsylvania R.R. made a full investigation of the accident, and reported to General Manager S. C. Long. An abstract of this report will appear in our next issue.

A Peculiar Building Accident occurred Dec. 2, 1912, in Rochester, N. Y. In a building undergoing reconstruction, the second-floor beams were supported temporarily by shores footing on a series of unbridged joists at first-floor level. Then building-materials were piled on the second floor, overloading it. The supporting joists tipped over and the floor fell. Four workmen in the cellar below were killed.

The Public Utility Commission Law passed not long ago by the legislature of Oregon was approved by popular vote on Nov. 5, having been brought before the people as a result of the referendum petitions. The act enlarges the powers of the former railroad commission, of which C. G. Aitchison is chairman.

The Commission Plan of City Government went into effect in New Orleans, on Dec. 2. Included in the five commissioners is Martin Behrman, who has served as mayor during the past eight years. Mayor Behrman will still be known as mayor, although with greatly changed powers, and will have under his direction the Department of Public Affairs.

The New Wireless Telegraphy Laws, affecting probably over 1000 vessels, are to go into effect on Dec. 13. After that date, government licenses will be required for all shore stations and for steamer equipments leaving American ports, and operators will also have to be licensed.

Every steamer with a carrying capacity of fifty passengers or more on trips exceeding 200 miles, will be required to have two operators for its wireless equipment so that a continuous watch can be maintained for distress signals. Safeguards are required to provide against any delay or interruption of the communication between the operating room and the bridge on each boat, and auxiliary machinery for continuing wireless communication in case of accident to the regular equipment, is also required.

These laws were framed shortly after the "Titanic" disaster and one of the provisions included is for giving the right of way to distress signals. The wording of this section is as follows:

All stations are required to give absolute priority to signals and radiograms relating to ships in distress; to cease all sending on hearing a distress signal, and except when engaged in answering or aiding the ship in distress, to refrain from sending until all signals relating to the distress call are completed.

The use for commercial messages, of the naval stations on the South Atlantic and the Pacific coasts, and of the army stations in Alaska, where there are no commercial stations, has been authorized by these new regulations.

The Pollution of the Cuyahoga River must be stopped by July 1, 1915, according to an order served upon the city of Cleveland, Ohio, by the State Board of Health a few weeks ago. The order, under the Ohio law, had the approval of the Governor and Attorney-General of the State. Soon after the order was issued, the city council authorized the issuance of $2,000,000 bonds for carrying out the order. A previous appropriation of $1,000,000 will also be available for the purpose. It is understood that sewage treatment works will be built, as well as an intercepting sewer.

Personals

Mr. John M. G. Watt, M. Am. Soc. C. E., has resigned his position of Assistant Division Engineer of the Pacific Division, Panama Canal.

Mr. J. D. Gallary, Trainmaster of the New York, New Haven & Hartford R.R., at Providence, R. I., has been promoted to be Superintendent, succeeding Mr. J. A. Droege, promoted, as noted elsewhere.

Mr. John Anderson, formerly Assistant Chief Engineer of the Union Electric Light & Power Co., St. Louis, Mo., has been appointed Engineer in charge of power plant of the North American Co., Milwaukee, Wis.

Mr. Gordon Kribs, M. Am. Inst. E. E., formerly Assistant to the Chief Engineer of the Pacific Power & Light Co., Portland, Ore., is now Assistant to the Chief Engineer of the Texas Power & Light Co., Dallas, Tex.

Mr. Henry E. Elrod, Assoc. M. Am. Soc. C. E., formerly General Manager of the Union Iron Works, Houston, Tex., has opened an office in the Southwestern Life Bldg., Dallas, Tex., as Consulting and Constructing Engineer.

Mr. George E. A. Pairley, Assoc. Am. Inst. E. E., a consulting engineer of Baltimore, Md., has been appointed Assistant to the Chief Engineer of the Baltimore Electrical Commission, at a salary of $2500 per annum.

Mr. Leonard Work has resigned his position with the Philadelphia office of the Westinghouse Electric & Manufacturing Co., to take up work with the Isthmian Canal Commission at Pedro Miguel, Canal Zone, Panama.

Mr. Allen E. Ransome, Assoc. Am. Inst. E. E., formerly with the Seattle, Wash., office of the Westinghouse Electric & Manufacturing Co., has been appointed Assistant General Manager of the Olympic Power Co., Port Angeles, Wash.

Mr. Edward J. Neary, Assoc. Am. Inst. E. E., Instructor in electrical engineering at the University of Pennsylvania, has resigned to accept a position on the staff of H. L. Doherty & Co., Consulting Engineers, 60 Wall St., New York City.

Mr. T. Kilpatrick, Superintendent of the Canadian Pacific Ry., at Revelstoke, B. C., has resigned. During his service in British Columbia with the Canadian Pacific Ry. he has established a reputation as an expert on snowshed construction.

Mr. W. T. Dobyns, formerly Road Master of the Virginia & South-Western Ry., at Bristol, Tenn., has been appointed Engineer of Maintenance-of-Way of the Southern Ry., at Greensboro, N. C., suceeding Mr. Thomas Bernard, promote., as noted elsewhere.

Mr. Albert J. Himes, Engineer-in-Charge of grade crossing removal on the New York, Chicago & St. Louis R.R., at Cleveland, Ohio, has been elected president of the Associate Alumni of Cornell University. Mr. Himes graduated from the University in the class of '87.

Mr. Joseph Ramsey, Jr., M. Am. Soc. C. E., has resigned as President and General Manager of the Ann Arbor R.R. He is succeeded as President by Mr. Newman Erb, Chairman of the Board of Directors, and as General Manager by Mr. H. H. Harrison, Vice-President.

Mr. Edwin F. Gruhl, formerly Statistician of the Wisconsin Railway Commission, has accepted a position with the North American Co., at New York City. Mr. Gruhl will study the organizations and efficiency of the smaller subsidiary companies and recommend changes and improvements.

Mr. Thomas Bernard, formerly Engineer of Maintenance-of-Way of the Southern Ry., at Greensboro, N. C., has been transferred to the office of the Chief Engineer of Maintenance-of-Way and Structures with the title of Assistant to the Chief Engineer. His headquarters will remain at Greensboro.

Mr. J. G. Walber, formerly Assistant General Manager of the Baltimore & Ohio R.R., at Baltimore, Md., has been appointed Assistant to the Third Vice-President and will have charge of a new bureau controlling of all matters relating to employees of the operating department, such as employment,, discipline and wage questions.

Mr. B. R. Pollock, General Superintendent of the New York, New Haven & Hartford R.R., at New Haven, Conn., has been promoted to be General Manager, with headquarters at New Haven, He is succeeded as General Superintendent by Mr. C. N. Woodward, Superintendent of the Shore Line division at New Haven. Mr. J. A. Droege, Suprintendent at Providence, R. I., succeeds Mr. Woodward at New Haven.

Mr. R. N. Begien, Assoc. M. Am. Soc. C. E., recently Assistant to the Third Vice-President of the Baltimore & Ohio R.R., and formerly Assistant to the Chief Engineer, has been appointed Assistant General Superintendent of the Main Line system. Mr. Begien graduated from the Lawrence Scientific School, Harvard University, and entered the engineering department of the Baltimore & Ohio R.R. in 1902, after several years' experience in Central and South America, and in the engineering department of the District of Columbia.

Obituary

Rufus A. Rager, for 20 years County Surveyor at Frederick, Md., died Dec. 2, at the age of 63 years.

Ernest Hexamer, a famous map publisher of Philadelphia, Penn., died in that city, Dec. 3. He is said to have been the originator of maps showing fire protection in cities, now used, by the National Board of Fire Underwriters.

George Albert Kimball, Director of the American Society of Civil Engineers, Chief Engineer of the Boston Elevated Ry., died Dec. 3, at his home in Boston, Mass. A biographical sketch of Mr. Kimball will appear in a later issue.

Dr. William A. Buckhout, Professor of botany and horticulture at the Pennsylvania State College, died Dec. 3. He was a member of the State Forestry Commission and made extensive investigations of the effect of smoke and gases on vegetation.

Charles S. Heller, member of the firm of Heller & Brightley, manufacturers of surveying instruments, Philadelphia, Penn., committed suicide, Dec. 1, by inhaling illuminating gas. He had long been a sufferer from heart trouble. He was 73 years old.

Sir George H. Darwin, Professor of astronomy and experimental philosophy at Cambridge University, England, died in London, Dec. 7. He was a son of the late Charles R. Darwin, the famous author of the "Origin of Species." Sir George Darwin is chiefly famous among engineers and scientists for his work on the harmonic analysis of tidal phenomena, on which all scientific tide predictions are now based. He was also the author of numerous other scientific works.

Silas Wright Burt, who died at his home in New York City, Nov. 30, at the age of 83 years, began his business career as a civil engineer. He graduated from Union College, Schenectady, N. Y., in 1849, and for 10 years was in railway engineering work in the Middle West and in Colorado. After the Civil War, during which he served his native state of New York in organizing and equipping the state militia, he served as Naval Officer of the port of New York. Later he was Chief Examiner of the New York Civil Service Commission.

Alfred Pancoast Boller, Vice-President of the American Society of Civil Engineers, senior member of the firm of Boller, Hodge & Baird, Consulting Engineers, New York City, died at his residence in East Orange, N. J., on Dec. 9, after an illness of several months. Mr. Boller was born in Philadelphia, Penn., Feb. 23, 1840, and graduated from the Rensselaer Polytechnic Institute with the class of 1861. He spent a lifetime in bridge engineering work and was one of the foremost authorities of the world on bridge engineering. He was a member of the Institution of Civil Engineers of Great Britain. A more extended account of Mr. Boller's life and work will appear in a later issue.

James M. Shanly, M. Am. Soc. C. E., died at his home in Montreal, Que., Nov. 29. He was born in Illinois in 1857 and received his education at the University of Toronto. He early entered into railway construction work and was Chief Engineer of the Beauharnois Junction Ry., now part of the New York Central Lines into Montreal. Later he was Chief Engineer and had charge of the construction of what is now the Ottawa Short Line Ry., a part of the Canadian Pacific Ry. In 1894 he became Chief Engineer of the Atlantic & Lake Superior Ry., and the Central Ry. of Canada. For several years he had been Consulting Engineer of the Canadian Pacific Ry., at Montreal. Mr. Shanly was a member of the council of the Canadian Society of Civil Engineers.

Engineering Societies

COMING MEETINGS

NATIONAL ASSOCIATION OF CEMENT USERS.
Dec. 10-14. Annual convention at Pittsburgh, Penn. Secy., E. E. Krauss, Harrison Bldg., Philadelphia, Penn.

AMERICAN SOCIETY OF AGRICULTURAL ENGINEERS.
Dec. 26-28. Annual meeting at Chicago, Ill. Secy., C. O. Reed, Urbana, Ill.

AMERICAN ASSOCIATION FOR THE ADVANCEMENT OF SCIENCE.
Dec. 30-Jan. 6. Annual meeting at Cleveland, Ohio. Secy., L. O. Howard, Smithsonian Institution, Washington, D. C.

MINING AND METALLURGICAL SOCIETY OF AMERICA.
Jan. 14. Annual meeting at New York City. Secy., W. R. Ingalls, 505 Pearl St., New York.

AMERICAN WOOD PRESERVERS' ASSOCIATION.
Jan. 21-23. Annual convention at Chicago, Ill. Secy., F. J. Angier, B. & O. RR., Baltimore, Md.

American Society of Mechanical Engineers—The following officers were elected for the ensuing year, at the annual meeting in New York City, Dec. 3-6: President, W. F. M. Goss; Vice-presidents, James Hartness, J. E. Moultrop and H. G. Stott; Managers, W. B. Jackson, H. M. Leland and Alfred Noble; and Treasurer, W. H. Wiley.

Engineers Club of St. Louis—The annual meeting of the Club was held on Dec. 4, and the following officers for 1913 were elected: President, John Hunter; Vice-presidents, A. P. Greensfelder, F. E. Bausch; Secretary, W. W. Horner; Treasurer, W. E. Rolfe; Librarian, H. M. Cryder; Directors, J. W. Woermann and Herman Spoehrer; Managers of the Association of Engineering Societies, E. B. Fay, W. S. Ashton, H. J. Finch and J. T. Garrett.

American Institute of Consulting Engineers—On account of the death of Alfred P. Boller, Past-President of the Institute, on Dec. 9, the meeting scheduled for Dec. 12 has been postponed to Dec. 18.

American Society of Agricultural Engineers—The annual meeting of the Society will be held at the Great Northern Hotel, Chicago, Ill., on Dec. 26-28, at which time a good deal of attention will be paid to the subject of the standardizing of agricultural machinery and parts and to a discussion of the advisability of holding a Gasolene Tractor contest in the United States. The following program is of interest, as showing the extent to which engineering methods are being applied to agriculture and its allied industries:

Thursday, Dec. 26. Afternoon. 'President's Address," by H. W. Riley; "Tests of Corn Planters," by O. W. Sjogren; "The Draft of the Plow," by C. A. Ocock and "Isolated Gas Lighting Plants," by Eugene Becker. Evening. Business meeting.

Friday, Dec. 27. Morning. "Testing of Gas Tractors," by L. W. Chase; "The Principles of Fuel Oil Engines," by Prof. C. F. Hirshfeld. Afternoon. "Standardization Work of the Society of Automobile Engineers," by E. H. Ehrman; "Standards in Agricultural Engineering," by J. B. Davidson; "Standards in Agricultural Machinery," by J. A. King; "Standards in Gas Tractor Construction," by W. J. Brandon. Evening. Banquet.

Saturday, Dec. 28. Morning. "Laboratory Exercises in Farm Machinery," by Daniel Scoates; "The Design of an Agricultural Engineering Building," by H. C. Ramsower; "The Relation between Shop Work and General Lectures in Agricultural Engineering," by L. J. Hart.

Engineering Literature

CONTENTS

CORRESPONDENCE:
Comments on the Review of "A Syllabus of Mathematics" 1117
REVIEWS:
Fire Prevention and Fire Protection as Applied to Building Construction, Reviewed by Frank B. Sanborn 1117
Elements of Hydraulics 1118
Rivers, Canals and Ports 1118
Analysis of Metallurgical and Engineering Materials 1118
A Text-Book of Rand Metallurgical Practice. Reviewed by F. W. Traphagen 1119
Practical Mathematics 1119
Primary Battery Ignition 1119
Successful Houses and How to Build Them 1119
Analysis of Paint and Varnish Products. Reviewed by Henry Williams 1120
Hygiene for the Worker 1120
Building Stones and Clay-Products 1120
Mineralogy: An Introduction to the Theoretical and Practical Study of Minerals. Reviewed by Heinrich Ries 1121
Fire Prevention 1121
Report of a Special Investigation Relative to the Indebtedness of the Cities and Towns of the Commonwealth of Massachusetts 1121
Report to the Mersey & Irwell Joint Committee 1121
The Mosquito: Its Relation to Disease and Its Extermination 1122
Pratique des Turbines Marines. Reviewed by D. W. Taylor 1122
Practical Information on Irrigation for British Columbia Fruit Growers 1122
Cyclopedia of Fire Prevention and Insurance 1122
The Principles of Structural Mechanics. Reviewed by Lewis E. Moore 1123
The Business of Mining 1123
A Treatise on Cement Specifications 1123
Standard Methods for the Examination of Water and Sewage 1124
The Gas Works Directory and Statistics 1124
Light: Its Use and Misuse 1124
PUBLICATIONS RECEIVED 1124

CORRESPONDENCE

Comments on the Review of "A Syllabus of Mathematics"

Sir—In looking over the Engineering Literature section of your issue of Nov. 14 I was struck with an idea that one of your reviewers failed to grasp the idea underlying the book he reviewed.

To read the review of "A Syllabus of Mathematics" one would imagine it to be a collection of rules and formulas, etc.; a book on the order of an aide-memoire, a pocket book collection of formulas and rules easily forgotten, like the excellent little work by Prof. Waterbury.

It was my understanding, when examining "A Syllabus of Mathematics," that it was produced as a guide for schools and colleges to show what is considered by experienced engineering educators and practical engineers to be the minimum requirements in the teaching of mathematics in technical schools. The book is not in any sense a textbook, nor even a book from which students may refresh their memory of studies long forgotten. It is purely and simply a statement put forth by experienced men to show what is considered essential as a part of the training all engineers should receive.

ERNEST MCCULLOUGH.

Monadnock Block, Chicago, Ill.,
Nov. 16, 1912.

REVIEWS

Fire Prevention

Reviewed by FRANK B. SANBORN*

FIRE PREVENTION AND FIRE PROTECTION AS APPLIED TO BUILDING CONSTRUCTION—A Handbook of Theory and Practice. By Joseph Kendall Freitag, B. S., C. E., Assoc. M. Am. Soc. C. E.; Author of "Architectural Engineering," etc. New York: John Wiley & Sons. London: Chapman & Hall, Ltd. Leather; 4½ x 7 in.; pp. 1038; 395 text figures. $4, net.

This volume of a thousand pages covers the broad field of insurance, fire hazards, construction, and protection, although treating more specifically of building construction. There are six parts: Fire Prevention and Fire Protection, Fire Tests and Materials, Fire Resisting Design, Fire Resisting Construction, Special Structures, Auxiliary Equipment and Safeguards. It is the first volume that has appeared in this country to include the whole of this new field of applied science.

Besides an extended treatment of various branches of fire protection, the author proposes certain distinctions by new definitions. But some of these distinctions instead of making the subject clearer, seem likely to cause misunderstanding: "Fire prevention," the author says, "has to do with the causes of fire; . . . also with educational measures and building laws; or other regulations which deal with preventive safeguards" and "fire protection as applied to buildings includes control of fire through construction, control by means of first aid or departmental work, detection of fire by automatic means and safety against exposure hazard." The need of this division between fire prevention and fire protection or the practical application of the distinction is not made evident.

Similarly a new definition of fire resistance is given. The author says: "Fire resistance has too often been confounded with non-combustibility"; and later, at considerable length, he defines a fire-resisting building as "one in which a fire starting within the structure will be confined, through the design and the inherent qualities of the building itself, to that compartment or unit of area within which the fire originates; or, if subjected to attack by fire from without, either through an adjacent fire or wide-spread conflagration, the building must be able not only to protect its own contents from destruction, but serve to protect itself in all essential particulars, and also to protect structures beyond, from the further spread of devastation." This definition seems long and involved, and does not make clear to the reviewer the distinction that the author wishes to establish between a fire-resisting building and a non-combustible one. Why not include all grades of construction from nearly-fire-resisting down to nearly-fast-burning (joisted, hollow structures) under a general classification of Slow Burning? In the furnace heat of a conflagration temperatures of 2200° F. occur; copper will melt. What building is then "fire re-resisting?" The best would seem to be but slow burning.

Fire-protection engineering has often been divided into the following four important sub-divisions: Construction, Occupancy, Protection, and Management. These sub-divisions were developed by John R. Freeman in 1890 and since then they have been widely used by various insurance organizations. Into these four groups may be placed all of the various elements that affect the quality of any fire risk. Each group may have within itself various gradations, as poor, fair, good, and excellent; thus ample range is provided for classification, and underwriter, engineer, and owner will see the correlation of these four groups. It is evident that all of the groups must rank high to make a first-class fire risk. This method of classification and grading has been extensively tested for twenty years and has been found to have increasing usefulness in practical application, but the author of the present volume has not followed or, so far as the reviewer can find, even mentioned this method of classification.

Certain faults are noted in the statements of definitions or subsequent relation of definitions to the make-up of the book: For example, the preface states that "In the past too much stress has been laid upon construction only . . .," yet nearly 800 pages—four-fifths of the book—are given to building construction and its affiliated branches.

To an unusual extent the book is based on quotations and extracts from various publications which, of course, is perfectly allowable, but which requires careful selection by the author lest unfairness be done and advertising features become a part of an influential text. There are 395 illustrations, mostly reproductions and nearly all taken from manufacturers' and insurance catalogs.

*Consulting Fire Protection Engineer and Professor of Civil Engineering, Tufts College, Mass.

Of 17 full pages of tables, 6 are quoted from publications of the Continental Insurance Co. of New York, and 7 from the National Fire Proofing Co. These two companies are thus given undue space, while parallel companies, of which there are many, are omitted, or given minor representation.

Similarly, in the chapter on watch clocks, one make of portable type is described and one make of magneto type, but reference is not made to a dozen or more other manufacturers of these same devices. A prospective purchaser would read of the advantages of portable clocks and of slight disadvantages that they have, but he would not find included a most serious objection, namely, the fact that they can be easily tampered with. A half-shrewd watchman can find ways of securing a set of duplicate keys and then wind all of the stations each hour, or for the night, while sitting in the boiler room or office. This is a serious objection to *any make* of portable watch clock, yet they have a proper field of service.

To show the efficiency of automatic sprinklers a table is given from a publication of one of the insurance companies, and the deduction is drawn that, since the cost of insurance has decreased from $0.2529 per $100 for 1850-1875, inclusive, to $0.0363 for 1896-1911, inclusive, that this reduction may be attributed to "the effect of sprinkler protection." Somewhat contradictory to the above there appears in the next paragraph another explanation: "The constant improvement year by year in matters of construction, fire-protection equipment, inspection and maintenance have naturally greatly reduced the cost of insurance." The reader is left to choose between these two statements. As a matter of fact, not automatic sprinklers alone, nor any one agency, has produced the reduction referred to, but instead a mutual organization of mill owners persistently working through the medium of an Inspection Department for improvements in Construction, Occupancy, Protection, and Management.

Under the heading of a Fire Protection Library are given, in quotations, a list of 17 books that are advised. This list would serve one class of insurance brokers, but would be poorly adapted to the needs of engineers and architects. For example, the list does not include Crosby and Fiske's "Handbook of Fire Protection," nor Freeman's treatise "On the Safeguarding of Life in Theaters"; yet both of the books are referred to in subsequent chapters and should be included in a present-day library.

The illustrations and lists of manufacturers of automatic sprinklers include but four of the six widely-approved makes. This is sure to cause injustice to the two that are left out.

The majority of builders, architects, and engineers that are immediately concerned with fire-protection problems consult such a book for rules, approved methods, actual examples, explicit instructions, and especially for information on costs. The cost data in the present volume could well be greatly extended, there being but two noteworthy references: One by quotations from a paper by C. T. Main on "The Approximate Cost of Mill Buildings," and another from a publication by F. J. T. Stewart on the "Cost of Items in Fireproof Buildings."

The general style of the book is that of exposition and description. It will be found especially interesting to a reader who is familiar with the elements of fire-protection engineering, but wishes to pursue by casual reading the story of fire, fire prevention and fire protection in their relation to our national progress.

One of the best chapters in the book is the one on the Theory and Practice of Fire Insurance. Here the duties of the insurance agent are stated, the method of rating, the tax that insurance brings to our whole country, and the method of reducing insurance as practiced by the stock companies—the methods of the mutual companies being but briefly described.

Two other well directed and valuable chapters, though brief, are on Slow Burning or Mill Construction and on Efficiency vs. Faulty Construction; the last represents the responsibility of owner, architect and contractor.

The whole science of fire-protection engineering is in a state of rapid development; rules and methods have not become established. Although the present volume needs extensive revision and modification it represents as it stands an immense amount of labor in compiling, editing, and developing information from a great variety of sources. It is a helpful step forward.

ELEMENTS OF HYDRAULICS—A Text-Book for Secondary Technical Schools. By Mansfield Merriman, Author of "Treatise on Hydraulics"; Editor-in-Chief of American Civil Engineers' Pocket Book. New York: John Wiley & Sons. London: Chapman & Hall, Ltd. Cloth; 5x7¾ in.; pp. vi + 156; 86 text figures. $1. net. (4/6, net.)

With the development of our numerous trade and manual-training schools there has come a pressing need for text-books on technical subjects which will at the same time be correct and elementary. Prof. Merriman's long experience in textbook writing eminently fits him for such a task. He states in the preface to his new book on elementary hydraulics that "the attempt has been made to give a presentation of the subject without the use of higher mathematics. The degree of preparation required is merely that now given in high schools, and includes only arithmetic, algebra, trigonometry and an elementary course in mechanics." At the same time the topics have been carefully selected with a view to their application to practical engineering work.

The subjects taken up are the elements of hydrostatic pressure, and of hydraulic flow, the effect of orifices and jets, the nature of flow through pipes, conduits and rivers, the measurement of water and a brief discussion of pumps and the simpler hydraulic motors.

RIVERS, CANALS AND PORTS. Two volumes. Bibliographic Notes of Articles Published in Periodicals from 1892 to 1910, inclusive. Compiled by Jean Pradelle, Librarian of the National School of Bridges and Roads, Paris. Brussels: Permanent International Association of Navigation Congresses; Executive Committee, Office of General Secretary, 38 Rue de Louvain. Flexible Cloth; 6x9 in.; pp. 729 and 710.

These two volumes form what appears to be a very complete international index of recent literature on rivers, canals, harbors, dams and allied structures. The entries are in the language of the original article, book or report. The field covered is much broader than might be expected from the title. Hydrology, hydrography and the hydraulics of rivers and canals are among the subjects indexed, while under harbors are considered such subjects as the mechanics of the sea, winds, currents, waves, etc.; means of protecting coasts, the lighting and buoying of coasts and channels, etc. Under processes of navigation are found many subjects ordinarily classed under naval architecture, as well as references to ship railways, ice-breakers and refloating of vessels.

The index is classified and divided into groups under such headings as those mentioned and indexed by authors' names. Editorials and anonymous articles are indexed by their titles. Each volume has an author index and a locality index in the back, which are useful in locating particular articles. The two volumes covering the years 1892 to 1910, inclusive, should prove valuable additions to any engineering library where engineering periodical files are kept. It is unfortunate that there are not similar works covering other fields of engineering.

ANALYSIS OF METALLURGICAL AND ENGINEERING MATERIALS—A Systematic Arrangement of Laboratory Methods. By Henry Wysor, B. S., Assistant Professor of Analytical Chemistry and Metallurgy in Lafayette College; Consulting Chemist and Metallurgist, Easton, Penn.; The Chemical Publishing Co. London: Williams & Norgate (14 Henrietta St., Covent Garden, W. C.) Cloth; 8½x10½ in.; pp. 82. $2. net.

This manual gives explicit directions to the student for the laboratory examinations of the most important engineering materials. The author directs attention to the experiment first and to the theory of a scheme later; he finds it necessary to apologize for thus breaking away from the old "logical" procedure, which is the reverse, although his plan is in accord

with most enlightened ideas of teaching science to beginners.

The leaves of the book are printed on one side only and the numbering is inconspicuous—a scheme which is planned to aid in revision from time to time as the student or instructor sees fit.

Rand Metallurgical Practice Continued

Reviewed by F. W. TRAPHAGEN*

A TEXT-BOOK OF RAND METALLURGICAL PRACTICE—Designed as a "Working Tool" and Practical Guide for Metallurgists upon the Witwatersrand and Other Similar Fields. By C. O. Schmidt, M. Inst. M. M., Member of Council of South African Institution of Engineers. Vol. II. London: Charles Griffin & Co., Ltd. Philadelphia: J. B. Lippincott Co. Cloth; 6¼x9 in.; pp. xxii + 438; 434 text figures; 32 tables. $6.50, net.

The second volume of "Rand Metallurgical Practice" maintains the high standard set by the authors of the first volume [reviewed by Prof. Traphagen in our issue of Aug. 15, 1912—ED.]. There are two sections. There is the same wealth of detail that is characteristic of Volume I and it is difficult in a brief review to select parts deserving special comment.

Section I deals with the design and construction of reduction plants and Section II with the transport of material. Under "General Considerations" the importance of starting with a small equipment is emphasized, as are also the value of careful experimental work and of securing correct estimates of cost. The value of the use of preliminary schematic arrangements of plants in plan and elevation, of complete flow sheets of treatment and volume diagrams as the basis for the development of the treatment and mill plan is excellently developed.

The chapter on "Sorting and Breaking" contains considerable suggestive matter and may well be carefully read by American engineers, who, with a few notable exceptions, have failed to take advantage of the gains from careful sorting.

Stamp and tube milling are given a complete chapter, in which the Nissen stamp receives considerable attention. This stamp, with its individual mortar and round screen, has some very large duties to its credit.

The advantage of the use of four tube mills in conjunction with stamps over stamps used with but one is strikingly illustrated in Table II. In the plant under consideration 75 stamps of 1640 lb. were first used with one tube mill; afterward three more tube mills were added. The change resulted in a difference in favor of the later installation of 30% per ton milled per day in capital outlay, 15.5% in power, 18% in labor, supplies, etc., and 29% in amortization, an average saving by the addition of the three tube mills of 18.5% on the last three items.

Various tabulations of capacities of tanks for sand and slime, of strength of supports, structural details, etc., are certain to be great time savers in the matter of calculations. Practically every phase of cyanide treatment is fully covered, and while many American devices fail to receive mention it would be a simple matter to substitute any such apparatus as were considered desirable. The chapter on estimating is very complete and the discussion of costs very satisfactory.

Reference to "Table XXVIII (p. 376)" as given on page 136 will necessitate further search, the table actually appearing on page 380.

Taken as a whole the book is excellent and invaluable to the practical cyanide man and constructing engineer.

*Professor of Metallurgy, Colorado School of Mines, Golden, Colo.

PRACTICAL MATHEMATICS, Being the Essentials of Arithmetic, Geometry, Algebra and Trigonometry. Part I. Arithmetic with Applications, and Part II., Geometry with Applications. By Claude Irwin Palmer, Assistant Professor of Mathematics, Armour Institute of Technology. New York: McGraw-Hill Book Co. Cloth; 4½x7 in.; pp. 139 and 150; 20 and 130 illustrations in text. Each part bound separately, 75c., net.

On the first page of Part I of this book the following paragraph appears:

"In the study of mathematics much time should be devoted: (1) to the expressing of verbally stated facts in mathematical language, that is, in the signs and symbols of mathematics; and (2) to the translating of mathematical expressions into common language."

This seems to be the keynote of the two books and, while there is nothing radically new in the methods of treating the various portions of the subject, the one thing which stands out most prominently is the fact that each point is very thoroughly explained and an unusually large and varied list of practical examples, involving each new conception or operation, is introduced to supplement these explanations.

Some of the special features were very evidently introduced as an aid to shop men and mechanics of various trades, for whom the books were particularly intended. A complete explanation is given of the metric system with a strong appeal for its adoption on the basis of greater simplicity and uniformity. Various machine parts, simple tools and short-cut methods are given thorough explanation with profuse illustrations. A number of useful tables are inserted in the text and at the end of each volume. The tables of contents and indexes make the works handy for reference.

Two features worth noting, as far as the physical appearance of the book is concerned (and this item is one which might be given much more attention to the mutual advantage of authors and readers in general) are that the regular type used is plain and clear cut and easy to read, and that important words, sentences, formulas and rules are made distinct by the use of italics and black-faced type.

PRIMARY BATTERY IGNITION — A Simple, Practical Pocket Guide on the Construction, Operation, Maintenance and Testing of Primary Batteries for Automobile, Motorboat and Stationary Engine Ignition Service. By C. Wadsworth, Jr., Formerly Principal, School of Automobile Running of the International Correspondence Schools; Managing Director, Technical Service, or Educational Department, the Studebaker Corporation. New York: D. Van Nostrand Co. Flexible cloth; 4½x7 in.; pp. 78. 50c., net.

The title of this little book suggests a restricted subject, but the text has further restricted the matter to "dry-battery" work largely. It is true that there is a short description of the copper oxide wet cell, but that is the only departure. The interests of gas-engine operators would have been better consulted if there had been a section of small and portable storage batteries — with a corresponding change of title.

The hints on the best methods of using dry batteries are well selected, though necessarily lacking in novelty. Of particular service is the matter on the constant use of voltmeter and ammeter in the ignition circuits to secure constant indication of battery condition. The most of the illustrations are very excellent, though a few are very poor.

House Building

SUCCESSFUL HOUSES AND HOW TO BUILD THEM—By Charles E. White, Jr., M. A. I. A., Author of "Some Western Houses," "Satisfactory Types of Garages," "When You Build a Little House," "How to Build a Fireproof House." New York: The Macmillan Co. Cloth; 5x7¾ in.; p. vi + 520; drawings by the author. $2.

Building a house for one's own use is one of the events of a life-time, but if the testimony of experience can be believed, it is not an unmixed pleasure. The ordinary man has very pronounced ideas as to some features of his future home and a vague general notion of design and construction, so he goes to an architect to insure the execution of his hobbies and at the same time to guarantee the trustworthiness and possibility of execution of the design. In balancing undreamed-of cost against available funds he generally finds that many of his hobbies go by the board. If it were possible to write a book which could inform laymen accurately as to the cost of houses, it undoubtedly would have a wide sale, but variations in location and in cost of material are such that it is probable that such a book could not be written. The next best thing, then, for the layman is to read some book on the general subject

which can inform him as to the proper elements that go to make up a successful house of moderate cost, for it is assumed that the wealthy man does not need to investigate the details of his home building as thoroughly as the one who is limited in the amount that he can spend.

Mr. White's book is lacking in the cost feature noted above, as are all other books on the subject, but otherwise it is eminently successful. A layman about to build can surely obtain from it a number of pointers which would materially assist him in his own design and in his study of the architect's plans and the builders' execution. The book is very complete and is well illustrated with a number of plans, views and detailed drawings of fixtures and trim. On the principle that it is not good for the client to know as much as his lawyer or his doctor, we presume that architects in general will not advise the general reading of this book. If, however, the reader does not assume a complete knowledge of architecture after his reading of the book, we think that he will be much benefited and that not only will his house be better suited to his needs, but he will prove a more acceptable client to those who serve him.

How to Analyze and Test Paints, Varnishes and Allied Materials

Reviewed by HENRY WILLIAMS, U. S. N.*

ANALYSIS OF PAINT AND VARNISH PRODUCTS—By Clifford Dyer Holley, M. S., Ph. D., Chief Chemist, Acme White Le 1 & Color Works. New York: John Wiley & Sons. London: Chapman & Hall, Ltd. Cloth; 5½x8¼ in.; pp. viii + 292; illustrated. $2.50, net (10/6, net).

As aptly stated by Dr. Holley, the pure-paint laws enacted by some states have done much to stimulate chemical analysis and research work into the properties of various paint products. They have stimulated, also, the production of excellent literature on the subject. Dr. Holley's book may be regarded in this class, and it is a valuable contribution.

It deals primarily, as is indicated by the title, with methods of analyzing and testing paints, oils, varnishes, pigments, driers and thinners. The book does not confine itself, however, to methods of analysis, but discusses ably the properties of many of the products and the manner in which they are employed ordinarily by the paint manufacturers.

Dr. Holley advocates requiring manufacturers of paint products to label their packages with a statement of the composition of the contained material and, in his introductory chapter, gives convincing arguments in favor of such laws. He admits, however, that chemical analysis alone will not enable the purchaser to select the best wearing paint, provided, and this proviso indicates his conservatism, each is composed of white lead, zinc oxide and possibly a small percentage of inert pigment.

The text, though treating, for the most part, of methods of chemical analysis and testing, is presented in very readable form and so many interesting facts are stated throughout as to render the book attractive even to the layman not concerned with detailed methods of analysis.

The first chapter deals with the methods of sampling paint and the separation of pigment from vehicle. The succeeding two chapters discuss the question of water and its emulsifiers, that is, the methods employed by manufacturers in incorporating water, as well as its detection and estimation. Three chapters are devoted to linseed oil and methods for its analysis. The author recognizes and states frankly the difficulties in detecting the presence of certain oils used as adulterants for linseed oil, but gives methods which he states have been found effective. Three chapters are given to the discussion of turpentine thinners and their substitutes, and Dr. Holley admits freely the equal efficacy to turpentine of petroleum turpentine substitute. One chapter is given to the inert pigments, though in this case no opinion is given as to their efficacy and properties. The analyses of white lead, sublimed lead and zinc oxide are treated in detail.

Two chapters are devoted to the methods of determining fineness, covering power and tinting strength of pigments and the practical "testing out" of paints. As to these latter questions the author states his opinion that they have more bearing on the value of a paint than the chemical analysis. He strongly urges the chemist to make his own tests and not to rely on a so called "practical man" who has no knowledge of chemistry. He gives excellent instructions for conducting such tests, including the construction of fences for exposure tests, referring to that used by the North Dakota Experiment Station as being convenient, practical and efficient.

Succeeding chapters deal with the analysis of mixed paints and colored pigments, driers, varnishes, shellac and stains. Specifications are quoted throughout for a number of the paint materials, among them several of those issued by the Navy Department, testifying in this manner to the excellence of these latter.

On the whole, Dr. Holley displays considerably more liberality toward the newer paint materials than reasonably might be expected, having in mind his position as chief chemist of a white-lead works. While naturally he is prejudiced toward a belief in the superiority of the older products, he refrains from any criticism or condemnation of the newer ones.

*Naval Constructor, U. S. Navy Yard, Brooklyn, N. Y.

HYGIENE FOR THE WORKER—By William H. Tolman, Ph. D., Director American Museum of Safety, and Adelaide Wood Guthrie, Department of Research, American Museum of Safety, New York City. Edited by C. Ward Crampton, M. D., Director of Physical Training, Department of Education, New York City. New York: American Book Co. Cloth; 5x7½ in.; pp. vii + 231; illustrated. 50c.

There are here combined in a single small, attractive, readable and readily understandable volume a mass of helpful instruction and suggestions on the making and preservation of sound minds and sound bodies through personal hygiene; on the prevention of industrial accidents; and incidentally, but none the less positively on that account, on making a success in business or industry through good habits. The text is singularly free from pseudo-scientific assertions, which mislead rather than help. The illustrations really illustrate. While the book is one of a series intended for school use, it is equally adapted to self-instruction. Employers would do well to distribute the book by the thousand among their employees young and old. The return would be manifold through increased efficiency of employees, besides which a public service would be rendered by contributing to the great health educational movement of the day.

BUILDING STONES AND CLAY-PRODUCTS—A Handbook for Architects. By Heinrich Ries, Ph. D., Professor of Economic Geology, Cornell University. New York: John Wiley & Sons. London: Chapman & Hall, Ltd. Cloth; 6x9½ in.; pp. ix + 415; 20 text figures and 59 page plates.

It is incumbent upon all architects to know the properties of various building stones and to recognize them in rough and finished form. A course intended to give such knowledge is presented in most of our architectural colleges. At Cornell University this course is given by Prof. Ries, and the present book is one prepared after some years' instruction in the subject, and follows the course of lectures given at that university. It takes up, first, a general but brief description of rock minerals and rock and the properties of building stone in general. Then follows specific chapters on igneous rock and gneisses, sandstones, limestones and marble, slate and serpentine. The latter part of the book is devoted to clay products and takes up the general properties of clay and describes in detail building brick, terra cotta, hollow block, roofing tile, wall and floor tile, and sewer pipe and sanitary ware.

The general chapters are abstracted forms of the larger books on rock products, and give only the more important facts in each case. In fact, the author states that for more specific information more detailed books should be consulted. Under the specific chapters on special types of stone, the qualities of the stone are given, their classification, and very valuable information concerning

their distribution. This latter part is given under the names of the states and the towns where the different stones occur, so that any particular district may be looked up and the kind of stone produced there easily ascertained. A very useful feature of the book is a reference to examples of the use of each kind of stone; thus, under the heading "Limestones and Marbles," sub-head, "Maryland," further sub-head, "Cockeysville," the local stone is noted as being used in the Washington Monument in Baltimore, the U. S. Post Office Building in Washington, etc. This will enable any reader to observe the condition of the stone in actual use.

While engineers in these days rarely have occasion to use building stone, they should find this book of great reference value for those times when they do. It furthermore gives in most concise form a wealth of information regarding those clay products which more frequently enter into engineering structures.

The Study of Minerals

Reviewed by HEINRICH RIES*

MINERALOGY: AN INTRODUCTION TO THE THEORETICAL AND PRACTICAL STUDY OF MINERALS—By Alexander Hamilton Phillips, D. Sc., Professor of Mineralogy, Princeton University. New York: The Macmillan Co. Cloth; 5½x9 in.; pp. viii + 697; 534 text figures. $3.75, net.

The last few years has seen the publication of a number of general or special works on mineralogy, each one differing in some respects from the others, which is but natural, since each author usually has his particular method of presentation. In the present case the object of the book is to bring together for the beginner, in concise form, the facts and basic principles of the several branches of mineralogy, unadulterated by an excess of data. The arrangement and contents as a whole differ somewhat from other American works, but on the other hand resemble to some degree that of Mier's excellent British work.

Part I deals with the crystallographic and optical properties of minerals. To the former 160 pages is devoted, this apparently large apportionment of space being due to the very free use of illustrative diagrams. The optical properties are then similarly elucidated.

Part II begins with a chapter on the relation of minerals to elements, a subject of importance, and one on which a clear conception of mineral compositions should be based. This is followed by an excellent but short chapter on the origin of minerals, in which the author makes a short digression into the field of economic geology. The physical properties of minerals, such as hardness, cleavage, specific gravity, etc., then follow.

All of the foregoing prepares the student for an intelligent understanding of the descriptions of mineral species which come after it. This part of the work emphasizes a common tendency of recent years, for the properties of the mineral species themselves are not only described, but their practical value and their occurrence in deposits of commercial value are also considered. The addition thus of a little economic geology serves to stimulate the student's interest.

This portion of the work contains numerous halftone illustrations, many of which are rather indistinct. However, it is not always fair to blame the author for this. Halftone cuts of minerals are unsatisfactory unless printed on inset sheets of highly calendered paper. If printed on the paper of the text they are almost invariably muddy and indistinct. Probably most authors realize this, but they are sometimes overruled by the publisher.

Part III is determinative mineralogy, and includes: (1) Blowpipe tests; (2) determinative table of minerals with the use of their physical properties; (3) a table for the determination of rock-forming minerals in sections; and (4) a table for determining minerals by their chemical tests.

The work closes with an excellent index, which would be still more useful if a locality list were added to it.

Professor Phillips is to be congratulated on producing such an excellent work, and one which should be of great use to every mining engineer. If properly advertised it will no doubt have a wide sale.

*Professor of Economic Geology, Cornell University, Ithaca, N. Y.

FIRE PREVENTION—By Edward F. Croker, Ex-Chief of the Fire Department of New York City. New York: Dodd, Mead & Co. Cloth; 5x8 in.; pp. x + 354; numerous illustrations. $1.50, net plus 15c. postage.

No one is better fitted to realize the terrible effect of fire and at the same time the requirements of fire protection than the active head of a large municipal fire department. Chief Croker was for fifteen years a subordinate member of the New York City Fire Department and for twelve years chief of that very efficient and hard-worked organization. In the course of those twenty-seven years he must have encountered practically every phase of the fire devil, and have formed very decided ideas both as to the way to fight it and the way to guard against it. Since his retirement, about a year ago, from the city's service, he has devoted his attention to the subject of fire prevention, and in a consulting capacity is advising towns and cities as well as owners as to methods of prevention and protection.

The book before us is called in the preface "Chief Croker's Rules of Strategy." It takes up the question of fire prevention from the small dwelling through its various stages to the equipment and governing of a large city's fire department. While incidentally referring to the necessity for construction which will be proof against fire, the book is mainly devoted to the protection of cities and buildings from other means than their own construction and to the problem of the fire department as a branch of the municipal government. The first part of this program demands chapters on the prevention of fire in the dwelling and in the small town, the protection of factories, loft buildings, etc., by the use of sprinklers, fire escapes, fire alarms, watchmen, etc., while the second part requires chapters on the fire department of a small town and further of large cities, together with descriptions of high-pressure systems, fire boats, fire-prevention bureaus, and fire marshals. The City of New York is drawn upon largely for as illustrating various points, but the book would be advantageous to the governing bodies of any city, large or small. The final chapters deal with high buildings and steel construction, incendiarism, and arson, and law making and fire-preventive work along legal and other lines.

REPORT OF A SPECIAL INVESTIGATION RELATIVE TO THE INDEBTEDNESS OF THE CITIES AND TOWNS OF THE COMMONWEALTH, Pursuant to the Provisions of Chapter 142, Resolves of 1911—By Charles F. Gettemy, Director, Bureau of Statistics. Boston: The Commonwealth of Massachusetts. Paper; 5½x9½ in.

Tabular summaries are here given of the debts of the 354 cities and towns of Massachusetts for the fiscal year 1910 (Nov. 30, 1910, to Apr. 1, 1911). The data include gross and net funded debts, gross and net general debt incurred within and without the "debt limit, so called," purposes of debt, and other pertinent facts. The investigation, which was ordered by the legislature, revealed much unsound city and town financiering and the inadequacy of existing laws designed to control indebtedness. The report recommends that cities and towns be restrained from meeting current expenses from permanent loans, and from improperly refunding loans; that sinking funds be abolished and bonds redeemed serially; and that city tax limits be raised or abolished. To prevent the incurrence of fixed debt for current expenses it is advised that the number of purposes for which bonds may be issued, as specified by statute, be increased from 6 to 15, and that it shall no longer be possible to issue bonds for non-specified purposes, as is now done under a vague general clause of the state laws. The life of bonds for the 15 purposes, the report advises, should be 30, 20, 10 and 5 years, according to the life or character of the object of the expenditure.

REPORT TO THE MERSEY & IRWELL JOINT COMMITTEE, May, 1912—By Hugh Stowell, Assoc. M. Inst. C. E., Chief Inspector, Manchester, England. Paper; 5½x8½ in.; pp. 33.

Large and small, the Mersey & Irwell Joint Committee has supervisory control

of the sewage disposal of 92 towns and rural districts, with a total population of 2,677,432, and also of the wastes disposal of 380 manufactories on the streams under their jurisdiction. Besides general summaries this report gives total and sewer-connected populations, dry-weather flow, method of sewage treatment, number of samples above and below limit (one grain oxygen absorbed per Imp. gal. in 4 hr.) during the two years 1910-11 and various remarks. The report is notable in that it gives a maximum of pertinent information in a minimum of space.

THE MOSQUITO: ITS RELATION TO DISEASE AND ITS EXTERMINATION—By Alvah H. Doty, M. D.; Formerly Health Officer of the Port of New York. New York and London: D. Appleton & Co. Cloth; 4½x6¼ in.; pp. 79; 11 illustrations.

In brief compass this little book gives the most essential facts regarding those mosquitoes which are a menace to health through spreading malaria and yellow fever, as well as those which are, so far as yet known, merely a pest. Means for mosquito reduction are outlined. The volume is non-technical and, being based on the author's successful experience in mosquito reduction on Staten Island, New York City, is eminently practical so far as it goes.

Marine Turbine Practice

Reviewed by D. W. TAYLOR*

PRATIQUE DES TURBINES MARINES By L. Jauch and A. Masmejean, Officers Mecaniciens de la Marine Anciens Eleves des Ecoles Nationales D'Arts et Metiers. Toulon (France): J. Alte. Paper; 5½x9 in.; pp. ix—243; 105 text figures; 10 folding plates. 8½ fr.

The authors of this volume on marine-turbine practice are two French naval engineers who have heretofore collaborated in producing works on marine engines and boilers. The book is distinctly practical in nature and is intended primarily for those who have to handle marine turbines.

Considering the volume seriatim we find first 15 pages treating of the theory of turbines and classifying the marine types into the usual classes, namely, impulse, reaction, and mixed. We then find 9 pages devoted to methods of varying the power of turbines and discussion of the excessive consumption of steam by marine turbines at reduced speeds. Then, after 15 pages devoted to discussing the distribution of power between shafts, methods of reversing, and of measuring power, we have 144 pages, or more than half the book, in which are described the construction and installation of all the types of turbines that have been used to any extent on shipboard. Then follow 15 pages upon the subject of condensing apparatus and finally 30 pages giving methods of operating and caring for marine turbine machinery.

*Naval Constructor, U. S. N., Navy Yard, Washington, D. C.

As may naturally be expected, the types of turbines treated most fully are those that have been used in the French Navy, more particularly the Parsons turbines which have been used for the largest and most recent French battleships. Other types are by no means ignored, an adequate amount of space being given to the Curtis, a leading American type, and to the German types, as well as to French types.

The authors point out that as patents expire there is a distinct tendency to settle upon a single mixed type of turbine for marine work, namely, one in which the high-pressure end is of the impulse type, and the low-pressure end of the reaction type.

The opinion is expressed that sooner or later the marine turbine will reach the same economy at low speed as present reciprocating engines. No information is given, however, as to the use of geared turbines, which during the last year or so have come to the front and undoubtedly constitute an advance in the direction of economy.

Also, while the authors describe mixed installations, consisting of a reciprocating engine to use the steam at high pressure and a turbine or turbines to use the exhaust from the engine, they do not cover mixed installations for low-speed work where, as in the United States, a reciprocating engine has been used on the same shaft as a turbine and, as in England, an oil engine has been similarly applied.

The descriptions, not only of the various types of turbines, but of the principles upon which they work, are particularly clear and logical, and as an elementary treatise on marine turbines from the practical point of view, this work must class as excellent.

PRACTICAL INFORMATION ON IRRIGATION FOR BRITISH COLUMBIA FRUIT GROWERS—By B. A. Etcheverry. Bulletin No. 44. Victoria, B. C.: Department of Agriculture, Province of British Columbia. Paper; 7x10 in.; pp. 119; 76 illustrations.

Within the limits indicated by its title, and those limits are not so narrow as might be thought, this appears to be a useful manual on the elements of irrigation engineering. Experience and investigations in the United States have been drawn upon freely, while first-hand knowledge of conditions in British Columbia was obtained by the writer by visits to the leading irrigated districts there. Line drawings and halftone views add to the value and interest of the bulletin. It may be added that Prof. Etcheverry is at the head of the Department of Irrigation, University of California, Berkeley, Calif.

Bulletin No. 28 of the Engineering Experiment Station of the Iowa State College of Agriculture and Mechanics Art is a pamphlet by Prof. John E. Brindley, of the college, on road legislation and administration in Iowa. Although the title would seem to apply only to one state, the bulletin contains a very complete resume of the state highway laws of all the states in the Union, and a tabulation somewhat in the same form as but containing different information from the tabulation which appeared in ENGINEERING NEWS, Mar. 28, 1912, p. 595, on the present status of state administration of highways in the United States.

Fire Prevention and Insurance

CYCLOPEDIA OF FIRE PREVENTION AND INSURANCE—A General Reference Work on Fire and Fire Losses, Fireproof Construction, Building Inspection, Inspectors' Reports, Private and Public Fire Protection, Common and Special Hazards, Chemistry of Combustion, Underwriters' Requirements, Fire Insurance Law, the Standard Policy, Rating, Underwriting, Brokerage, Settlement of Losses, etc. Four volumes. Prepared by Architects, Engineers, Underwriters and Practical Insurance Men. [Jessie M. Shepherd, Managing Editor.] Chicago: American School of Correspondence. Cloth; 6½x9¾ in.; pp. 455, 554, 487 and 425, respectively. $18.80.

Like the other and previous publications of the American School of Correspondence, this cyclopedia consists of a series of articles on related subjects by different authors. The present one has about 20 authors and collaborators, each of whose contributions is in separate form and is paged independently so that they may be published separately at some future time. A running pagination goes through the entire set. Primarily, the book is intended for the use of the correspondence students of the school, but, secondarily, it is hoped that it will form a textbook or a reference book for the general practitioner.

While the general subject is fire prevention and insurance, only a small part of it is of interest to structural engineers. At least three of the volumes are given over to questions of insurance, reports, inspection, hazards, law, underwriting, rating, etc., all of which are more strictly in the province of the fire-insurance specialist. The first volume, which is devoted entirely to matters more particularly interesting to engineers, is divided into three parts. The first is a general article on Fire and Fire Losses by F. W. Fitzpatrick, which describes in some detail the recent large conflagrations in this country and presents figures showing the great losses annually incurred. The second part, entitled Fireproof Construction, by Mr. Fitzpatrick and T. L. Condron, apparently is supposed to be instructive to builders and engineers. It is, however, a very general discussion of the subject, which makes fairly interesting reading to one who already knows the subject. Unfortunately, Mr. Fitzpatrick takes the position as a special pleader for clay tile as against concrete, which biased stand destroys his usefulness as a writer on the subject. Ap-

parently, Mr. Condron has written the special section on concrete construction, for this does not agree in many ways with the previous treatment of the subject under Mr. Fitzpatrick's authorship. A final section, also by Mr. Fitzpatrick, is devoted to a proposed national building code.

Volume II contains one article on building construction, by P. J. McKeon, which takes up the details of framing and fitting favorable to a fire-resisting construction. The remainder of the volume is given over to descriptions of fire-protection apparatus, and inspection reports, and common and special fire hazards. Volumes III and IV are devoted entirely to the insurance phases of the subject.

Elementary Structural Mechanics

Reviewed by LEWIS E. MOORE*

THE PRINCIPLES OF STRUCTURAL MECHANICS, Treated Without the Use of Higher Mathematics — By Percy J. Waldram, Lecturer on Structural Mechanics, Architectural School, Central School of Arts and Crafts, London. New York: D. Van Nostrand Co. London: B. T. Batsford. Cloth; 5x8 in.; pp. xviii + 369; 203 text illustrations. $3, net.

The book under review was written with the object of presenting the fundamental principles of Structural Mechanics simply and of "explaining to draftsmen the construction and genesis of those formulæ which are in common use."

The book is divided in six parts and 31 chapters. The first part, Leverage and Graphic Statics, deals with the simplest cases of forces, leverage, and reactions by analytical and graphical methods.

The second part, Beams and Girders, takes up first bending and resisting moments and their graphical representation. The calculation of moments of resistance and moments of inertia of various sections is followed by chapters on shear. In this connection the author takes up the question of the pitch of flange rivets in plate girders by the so called approximate method, following the practice which would be condemned by American engineers of selecting a ¾-in. rivet and the pitch and then determining the thickness of web plate necessary to give the requisite bearing strength for the assumed size and pitch of rivet. He also makes the following statement: "In riveting additional flange plates on to rolled joists to form compound girders, it must be remembered that each element of the flange takes its own share of the flange stress, and, therefore, the single shear on the rivets on the outside plates is caused by only a proportion of the total shear intensity as obtained from the bending moment diagram." Perhaps the ordinary draftsman can understand from this how to compute rivets in such cases, but the reviewer cannot. There is no mention made of the exact method of computing such rivets. A chapter on deflection follows, in which the fact that stiffness is not necessarily a criterion of strength is brought out clearly. The deflection of various types of beams is discussed and formulas are deduced which avoid the use of the moment of inertia of the sections.

The third part deals with Walls and Foundations. Earth pressure is taken up according to the theory of Dr. Scheffler. The principle is laid down without reserve that the retaining wall only supports half the wedge of earth between the back of the wall and the surface, making an angle with the horizontal equal to that of the angle of repose. If one applied this principle in all cases there would be conditions where it would lead to serious disappointment.

The fourth part takes up Roofs and Roof Trusses. The author's remarks concerning wind pressure and common errors in the computation of collar and particularly hammer beam trusses are very much to the point.

The fifth part is on Arches and Domes. As is to be expected when one considers that the book is written for men who have had no technical training, arches are treated entirely by the line of thrust method. The thrust at the crown is, however, found by analytical rather than graphical methods. This chapter could have been improved by using the purely graphical method. In a book of this character, the treatment of the subject of domes is, as is to be expected, very elementary, and the element of wind pressure is dismissed by using only a load roughly corresponding to the vertical component of the wind pressure.

Part six treats of columns and shoring and indicates in a general way the forms and limits of the various column formulas. It does not take up questions of detail and proper distribution of material, which might have been included and which would materially increase the usefulness of the chapter.

Considered as a whole, the book puts forth the fundamental principles in a nonmathematical way and is suited to the readers for whom it is intended. The technically trained engineer, however, could not gain much information from it. The author's style is very diffuse and not always clear, and it appears that the book could easily have been compressed into half the number of pages.

*Structural Engineer; Assistant Professor of Civil Engineering, Massachusetts Institute of Technology, Boston, Mass.

The Association of American Portland Cement Manufacturers has issued a 95-page booklet entitled "Concrete Highways," which may be obtained by writing to the office of the Association in the Land Title Building, Philadelphia. It describes the various types of concrete pavements and concrete foundations for pavements, tabulates the data concerning such construction in various cities of the United States and illustrates by photograph and description a number of such highways which have been successfully built.

THE BUSINESS OF MINING—A Brief, Non-Technical Exposition of the Principles Involved in the Profitable Operation of Mines. By Arthur J. Hoskin, M. E., Consulting and General Mining Engineer; Western Editor "Mines and Minerals." Philadelphia and London: J. B. Lippincott Co. Cloth; 5x7⅜ in.; pp. 224; 18 text figures. $1.50, net.

As the title would seem to indicate, this is not a book for engineers or experienced mine operators—though there are some discussions, of what may be called the "lack of ethics" which the mining business has often exhibited, that could profitably be read by operators.

A large part of the book is filled with amplified definitions of mining terms. It might perhaps safely be called a popular "dictionary of mining," except that it also is more. There are brief essays on finance, equipment, management, and the outlook of the industry. The author finds no objection to capitalizing a "prospect" in large, round numbers and in floating the stock at what it can be made to bring; what is condemned is the apportionment of 50 or 60% of the total stock to the promoters and attempts to float operations on sales of such a small margin. The trend of the text throughout is along a conservative middle ground—never rising to optimistic heights or sinking to depths of pessimism.

A TREATISE ON CEMENT SPECIFICATIONS, Including the General Use, Purchase, Storage, Inspection and Test Requirements of Portland, Natural, Puzzolan (Slag) and Silica (Sand) Cement and Methods of Testing and Analysis of Portland Cement. —By Jerome Cochran, author of "Inspection of Concrete Construction." New York: D. Van Nostrand Co. Cloth; 5½x8¾ in.; pp vii + 101; illustrated. $1, net.

While this book undoubtedly contains all the information necessary to an engineer in making up a specification for the purchase of cement, it is unduly long and drawn out. A few pages of general instruction followed by the standard American cement specifications would have been sufficient.

LIGNITE IN MONTANA—By W. R. Calvert, C. F. Bowen, F. A. Herald, J. H. Hance, Eugene Stebinger and A. L. Beekly. Bulletin 471-D (Advance Chapter from Bulletin 471, "Contributions to Economic Geology, 1910, Part II"), U. S. Geological Survey, George Otis Smith, Director. Paper; 6x9¼ in.; pp. 176; 3 text illustrations and 14 folding plates.

According to this report, eastern Montana has enormous deposits of lignite, which, although little used as yet, may eventually prove a fuel resource of great value. A single field is believed to contain over 25 billion tons of lignite within 500 ft. of the surface, while a second field has over 18 billion tons.

Water and Sewage Analysis

STANDARD METHODS FOR THE EXAMINATION OF WATER AND SEWAGE—American Public Health Association, Laboratory Section. Second edition. New York: The Association, 289 Fourth Ave. Cloth; 6½x9½; pp. vi—144. $1.25, postpaid.

In 1905 there was published a volume entitled "Report of the Committee on Standard Methods of Water Analysis to the Laboratory Section of the American Public Health Association." In 1908 two committees were appointed to prepare a new edition of the "Standard Methods": one on chemical analysis of water and sewage, with Earl B. Phelps as chairman, and one on bacterial tests of water and sewage, with D. D. Jackson as chairman. The volume before us presents the results of the work of those committees. Some changes have been made in the original text and new matter has been added, including methods and subjects of analysis not previously included. In their joint preface the two committees express the belief that the procedures described represent the consensus of opinion of laboratory workers throughout the country "and fairly represent the best practice in American laboratories."

As regards one important change made in the new edition there seems to have been strong objections from some of the leading bacteriologists of the country. We refer to the substitution of agar for gelatin as a culture medium for bacterial counts, with incubation at 37° C. for 24 hours instead of for 20° C. for 48 hours. We understand that as a result of discussion and action at the meeting of the Association in Washington last September the Laboratory Section of the Association passed a resolution to the effect that both counts be used during the ensuing year.

THE GAS WORKS DIRECTORY AND STATISTICS, 1912-13—With a List of Chairmen, Managers, Engineers and Secretaries, and Lists of Associations of Engineers and Managers. (Revised to August, 1912.) London: Hazell, Watson & Viney, Ltd. Cloth; 5½x8¾ in.; pp. 488. 10/6, net.

Besides giving the leading officials of the gas works of England and Wales, Scotland, Ireland and a few foreign and colonial works with London offices, the thirty-fifth issue of this useful annual gives financial and physical statistics for the various works, and prices received for gas and coke.

LIGHT: ITS USE AND MISUSE—A Primer of Illumination Prepared Under the Direction of the Illuminating Engineering Society. New York: The Society, 29 W. 39th St. Paper; 6x9 in.; pp. 20; 19 illustrations.

The Illuminating Engineering Society has ssued a primer on illumination entitled "Light: Its Use and Misuse." It is intended in this way to disseminate authentic information in the proper utilization of artificial light. First there is matter on the physiological effects of flicker, glare, poor direction, too strong contrasts, etc. There are general hints on the best use of modern fixtures—including shades, globes and reflectors. There are finally a few figures on the amount of light to be employed for various purposes.

Publications Received

[So far as possible the name of each publisher of books or pamphlets listed in these columns is given in each entry. If the book or pamphlet is for sale and the price is known by the editor the price is stated in each entry. Where no price is given it does not necessarily follow that the book or pamphlet can be obtained without cost. Many, but not all, of the pamphlets, however, can be secured without cost, at least by inclosing postage. The amount of postage necessary can be estimated approximately from the stated size of the book or pamphlet and the number of pages it contains. Reprints of papers read before engineering societies and printed by the authors for private circulation can often be obtained without cost by addressing the author, whose name and address is always given when known. Persons who are in doubt as to the means to be pursued to obtain copies of the publications listed in these columns should apply for information to the stated publisher, or in case of a reprint of a society paper to the author of the paper. The stated American prices of foreign books are based on 40 cents per shilling and per mark for British and German books, respectively, and 30 cents per franc for French books, the extra allowances being for importation costs.]

ANNUAL REPORT OF THE MINES DEPARTMENT, UNION OF SOUTH AFRICA, For the Calendar Year ended Dec. 31, 1911—Part I by Secretary for Mines and Commissioner of Mines for Natal, H. Warington Smyth; Part II by Acting Government Mining Engineer, R. N. Kotze. Paper; 8x13 in.; pp. xlvi + 135; 38 tables.

BOUNDARIES AND LANDMARKS — A Practical Manual. By A. C. Mulford. New York: D. Van Nostrand Co. Cloth; 5¼x8¼ in.; pp. vii + 89; 19 text illustrations. $1, net.

BULLETINS, UNITED STATES GEOLOGICAL SURVEY—George Otis Smith, Director. Washington, D. C.: Pub. Docs. Paper; 6x9¼ in.

Nos. 471 F and G: Advance Chapters from Bulletin 471, "Contributions to Economic Geology," 1910, Part II."

F—Coal Fields in Eastern Wyoming. By J. A. Davis, C. H. Wegmann and D. E. Winchester. Pp. 95; 12 folding plates.

G—Coal Fields of the Wind River Region, Fremont and Natrona Counties, Wyoming. By E. G. Woodruff and D. E. Winchester. Pp. 53; 9 folding plates.

Nos. 515 and 518: Results of Spirit Leveling in Pennsylvania and Ohio, 1899 to 1911, inclusive. Pp. 164 and 198, respectively.

No. 531-B: Oil and Gas Development in North-Central Oklahoma. By Robert H. Wood. Pp. 31; one folding map.

EXPLOSIVES—A Synoptic and Critical Treatment of the Literature of the Subject as Gathered from Various Sources. By Dr. H. Brunswig. Translated and Annotated by Charles E. Munroe, Ph. D., L.L.D., and Alton L. Kibler, M. S., Ph.D., George Washington University. New York: John Wiley & Sons. London: Chapman & Hall, Ltd. Cloth; 5¼x8¼ in.; pp. xv — 350. $3, net.

THE INDICATOR HANDBOOK: A Practical Manual for Engineers — By Charles N. Pickworth, Whitworth Scholar; Editor of "The Mechanical World"; Author of "The Indicator: Its Construction and Application," "The Slide Rule" and "Logarithms for Beginners." Part II. The Indicator Diagram: Its Analysis and Calculation. Fifth edition, revised and enlarged. Manchester: Emmott & Co., Ltd. London: Whittaker & Co. New York: D. Van Nostrand Co. Cloth: 4¾x7½ in.; pp. 139; 156 text figures. 3/-, net.

[The author states that some extensive revisions and additions have been made in this edition, particularly as regards diagrams for gas and oil engines, in connection with which some twenty illustrations have been added. For notices of earlier editions see our issues of June 16, 1906, and March 16, 1911].

MOTOR CAR CONSTRUCTION—A Practical Manual for Engineers, Students and Motor Car Owners, with Notes on Wind Resistance and Body Design. By Robert W. A. Brewer, Fellow of the Society of Engineers, Author of "The Art of Aviation." New York: D. Van Nostrand Co. London: Crosby Lockwood & Son. Cloth; 5¼x8¾ in.; pp. xi + 242; 78 text illustrations. $2, net.

OFFICIAL STATISTICS, COMMONWEALTH OF AUSTRALIA—Population and Vital Statistics, Bulletin No. 29, and Commonwealth Demography, 1911, and Previous Years. Melbourne: Commonwealth Bureau of Census and Statistics. Published under the authority of the Minister of Home Affairs by G. H. Knibbs, Commonwealth Statistician. Paper; 8x13 in.; pp. 233.

OFFICIAL YEAR BOOK OF THE COMMONWEALTH OF AUSTRALIA, NO. 5, 1912 — Containing Authoritative Statistics for the Period 1901-1911 and Corrected Statistics for the Period 1788 to 1900. Melbourne: Commonwealth Bureau of Census and Statistics. Published under the Authority of the Minister for Home Affairs by G. H. Knibbs, C. M. G.; Commonwealth Statistician. Cardboard; 6x9½ in.; pp. xl + 1277; numerous maps.

STRUCTURAL DETAILS OF HIP AND VALLEY RAFTERS — By Carlton Thomas Bishop, C. E., Assistant Professor of Civil Engineering, Sheffield Scientific School, Yale University. New York: John Wiley & Sons. London: Chapman & Hall, Ltd. Cloth; 10½x8 in.; pp. v + 72; 43 text figures. $1.75, net (7/6, net).

THE THEORY OF ENGINEERING DRAWING—By Alphonse A. Adler, M. Am. Soc. M. E., Instructor in Mechanical Drawing and Designing, Polytechnic Institute, Brooklyn, N. Y. New York: D. Van Nostrand Co. Cloth; 5¾x9¼ in.; pp. xv + 312; 273 illustrations. $2, net.

THIRTY-FIFTH ANNUAL REPORT OF THE BOARD OF HEALTH OF THE STATE OF NEW JERSEY, 1911, and Report of the Bureau of Vital Statistics. Bruce S. Keator, M. D., Secretary. Trenton, N. J.: State Gazette Publishing Co. Cloth; 6x9 in.; pp. viii + 678; illustrated.

TRIENNIAL REVENUE REPORT OF THE PUBLIC WORKS DEPARTMENT, IRRIGATION BRANCH, MADRAS, For the Three Years Ending 1910-1911. Madras: Printed by the Superintendent, Government Press. Cardboard; 8x13½ in.; pp. viii + 211; 17 folding maps (one in pocket) and several page illustrations.

THE UNA-FLOW STEAM ENGINE—By Prof. J. Stumpf, Technische Hochschule, Charlottenburg, Germany. New York: D. Van Nostrand Co. London: Constable & Co., Ltd. Cloth; 8x11 in.; pp. 29; 250 illustrations. $3.50, net.

UNIVERSITY OF ILLINOIS STUDIES IN THE SOCIAL SCIENCES, Vol. 1. No. 3, Sources of Municipal Revenues in Illinois—By Lent Dayton Upson, Ph. D., Sometime Fellow in Political Science, University of Illinois. Urbana-Champaign, Ill.: Published by the University. Paper; 6¼x9¾ in.; pp. 126. 75c.

UNTERSUCHUNGEN UBER DEN ZUSAMMENHANG DER ERSCHEINUNGEN IN WASSERLAUFEN AUF GRUND HYDROMETRISCHER ERHEBUNGEN. Zur Förderung des Flussbaues und Seines Unterrichtes für Studierende und Ingenieure—By Ing. C. Krischan. Graz (Austria): "Leykam." Paper; 7¼x10 in.; pp. 150; 1 text illustration, and 19 plates, arranged in a portfolio 12x13½ in. 15 K.

WIE LERNE ICH SKIZZIEREN?—33 Tafeln mit 264 Abbildungen und ausführlichem Text für alle technischen Berufe zum Selbstunterricht. Von Ad. Vieth, Professor, Regierungsbaumeister a. D. und Oberlehrer am Technikum der freien Hansestadt Bremen. II. Auflage. Bremen: Selbstverlag des Verfassers Ad. Vieth. Paper; 5¾x8 in.; pp. 47 (plates 7¼x10 in.). 3 Mark; American price, $1.20, net.

[A very good set of model- and instruction-plates for freehand mechanical sketching, with a brief explanatory text].